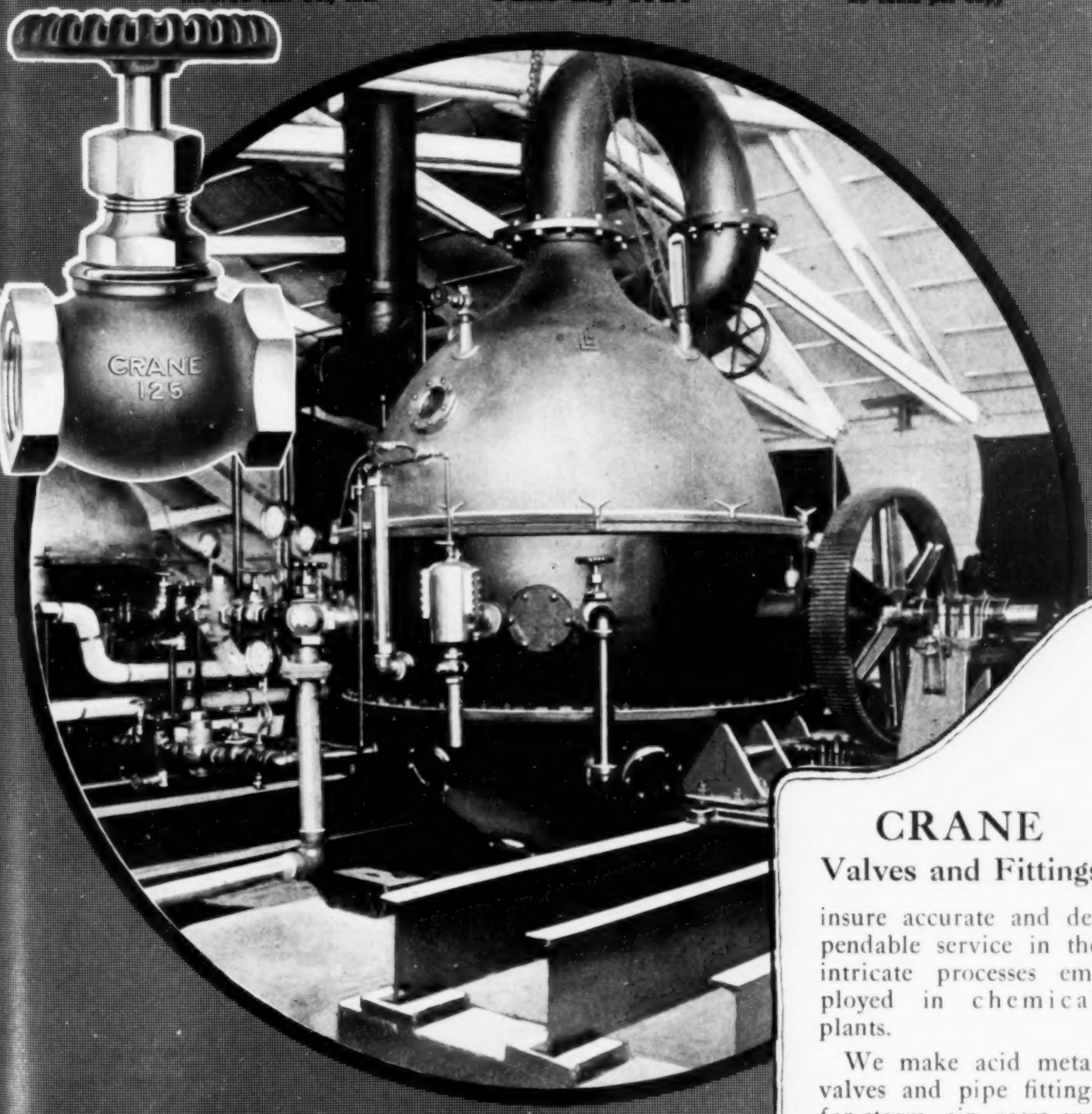
CHEMICAL & METALLURGICAL ENGINEERING

McGraw-Hill Co., Inc. June 22, 1921 25 cents per copy



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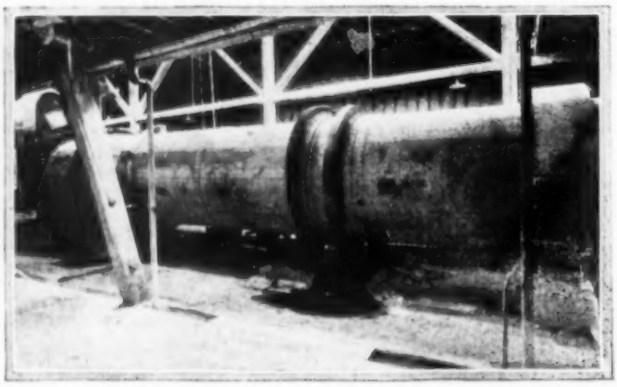

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Volume 24 | New York, June 22, 1921 | Number 25

Useful Statistics for The Chemical Industries

STATISTICS should be useful as well as interesting. We note, with a great deal of interest, the preliminary figures for the quinquennial census of manufactures, which indicate that in 1919 the chemical industries and those closely allied with them had an output valued at 15.65 billions of dollars, or almost exactly one-quarter of the total for all manufactures of the country. To the historian and the economist these figures are of value, but they are not useful in the sense that they are vital to the daily conduct of business. There is a recognized need for quick diagnosis.

Recently the report of the American Engineering Council's committee on the elimination of waste in industry pointed out that, among other needed reforms, "A national industrial information service should be established to furnish more timely, regular and complete information covering current production and consumption and stocks of commodities." This is in keeping with Mr. HOOVER'S announced plans for making the work of the Department of Commerce more effective as an aid to business. The Secretary has repeatedly advocated the collection of industrial statistics which would be broad enough in scope to furnish an accurate picture of the business conditions of the country, and at the same time would be limited to a relatively few articles for which the data could be quickly compiled and distributed. Fortunately such a movement is already in progress. Directly following a recent conference between Mr. HOOVER and representatives of the industry, the Census Bureau has prepared to collect and publish promptly the monthly production and stocks of a few basic chemicals which will serve as an index to the trend of business in the chemical industries. A tentative list of a half-dozen commodities has been selected, and included in this number, of course, is sulphuric acid, the recognized barometer of all industrial activity. Later, perhaps, the work thus started can be extended. Additional commodities can be covered or the field can be broadened to include other useful data, such as the proportion of the productive capacity in actual operation, stocks in the hands of dealers and consumers, and wholesale and retail prices.

Much benefit can confidently be expected from this service. A program of industry based on accurate statistical information will encourage the manufacturer to produce his output for a consuming rather than a speculating market. The consumer will be assured of a safe and adequate supply at a price determined by sound economic principles. Waste caused by unbalanced production will gradually be eliminated.

Our chemical manufacturers should be among the first to recognize this opportunity, and we feel justified, therefore, in urging their support to the Government's efforts to establish a useful statistical service.

Industrial Alcohol And Prohibition

"INDUSTRIAL alcohol be dammed; you know it's all booze." This statement, reported to have been made by one high in the councils of prohibition, expresses rather forefully a belief which is all too prevalent among laymen. Misconceptions such as this have been largely responsible for certain pending legislation, the enactment of which will mean disaster for the chemical industries. The ostensible purpose of the Volstead supplemental prohibition bill is to prevent the use of beer as a medicine, but it has been used as a means of striking a blow at industrial alcohol, the chemical essential to the production of important medicinals and pharmaceuticals, of dyes and organic chemicals, of celluloid and smokeless powder, and of innumerable other daily necessities.

It is a well-known fact that the new legislation is sponsored by the Anti-Saloon League and has largely been brought about through its influence. The prime movers in this powerful organization are either ignorant of the requirements of the chemical industries or, with complete disregard of the national welfare, have determined to penalize these industries because prohibition has failed in certain important respects. It has been proved conclusively that these failures are attributable to maladministration of the national prohibition act and not to inadequate law. Representatives of the chemical industries in a recent meeting, which is reported elsewhere in this issue, have vigorously protested against the administration of the existing act by careless, inefficient prohibition officials, whose ignorant and often criminal laxity has continually discouraged and annoyed legitimate enterprise.

The national prohibition act gave industrial alcohol a definite legal status, since one of its expressed purposes was "to insure an ample supply of alcohol and to promote its use in scientific research and in the development of fuel, dye and the lawful industries." Another section of the law was designed "to place the non-beverage alcohol industry and other industries using such alcohol as a chemical raw material or for other lawful purposes upon the highest plane of scientific and commercial efficiency."

The proposed supplementary legislation in many ways nullifies the provisions of the original act. For instance, the unrestricted use, under proper regulations, of non-beverage alcohol is repealed and the power is given to the prohibition commissioner to grant only "the permits that are necessary to supply the actual needs for non-beverage purposes and shall limit the supply and use of all liquor save denatured alcohol and denatured rum, unfit for internal use, to such non-beverage purposes." Objection is also raised to the new bill because it is believed that the dual control of applications and permits by the Attorney General and the prohibition

commissioner will place additional delay and restrictions in the path of the legitimate consumer. Other features viewed with alarm are the provisions that the applicant must post a public notice that he intends to use alcohol in his business and that "any federal or state officer or *any* person authorized thereto by any such officer may oppose any such application." The alcohol user is thus not only given the former status of the saloonkeeper but the conduct of his business is safely placed in "official" hands.

The new Volstead bill, whether it is enacted or not, has proved a lesson to all friends of industrial alcohol. It has pointed out an urgent duty to be performed by chemists individually and as a profession. The public must be educated to appreciate the difference between industrial alcohol and "booze"; the essential needs of the chemical industries must be recognized. The layman must be brought to a realization of the important rôle played by alcohol—the chemical—in the industries which contribute his medicines, his foods, his recreation and his defense.

High Costs in Producing Steel

WITHIN the space of a single twelvemonth we have two cases, arising from precisely opposite influences, of the abnormally high cost of producing steel. A year ago and less the cost was abnormally high because the demand was exceptionally heavy. Now it is because the demand is exceptionally light.

In the summer of last year blast furnaces paid $18 and more per net ton at ovens for Connellsville coke, and steel mills paid $12 and more per net ton at mine for gas and steam coal. Some workmen got bonuses or special emoluments for working or for being on hand with a chance that they might work. They were classed in some cases as being more skilled than they were, so that they could be listed on the payroll at higher wage rates. All this was done simply to swell production slightly. Not all mills engaged in these practices, there being some well-marked exceptions. Those that did could have run along with a slightly lower output and a much lower cost of production, but demand was exceptionally insistent and fancy premiums, over and above fancy base prices, were bid for prompt shipment of steel.

At the present time the cost of producing steel is abnormally high because the demand is so very light. In calling the production cost abnormally high it is meant that if mill-working conditions now, as to tonnage relative to capacity, were the same as in 1897 and 1898, with full allowance for increased rates of wages, freight rates and prices of supplies, but with the advantage of improvements that have been introduced, the cost of making steel would be much lower than is being shown by the cost sheets.

The extra cost at the present time is not due entirely to poor distribution of overhead, though that is obviously an important factor. Bond interest to be paid by 15,000 or 25,000 tons a month instead of by 100,000 tons falls very heavily per ton, but that might be taken care of. It is not necessarily unbusinesslike to spread fixed charges over periods of time. There is much more in the high costs of today than that, for various items of operating expense are heavy per ton, when they would disappear entirely if the plant were idle. In particular, the labor cost with the present low operating rates is exceptionally high. It is not a matter of wage rates per hour, but of the number of man-hours per tons of output. A plant producing at 25 per cent of capacity has much more than 25 per cent of a full payroll.

Last year relief from high costs might have been proposed by making buyers wait their turn, giving the buyers only the steel that could be produced economically. The buyers, however, refused to wait. They needed the steel just then, and some of them doubted very much whether they would need steel later. The mills probably agreed with this view, though they had no occasion to say so.

As for relief at present, making stocks of steel against possible requirements in future is out of the question. As a rule the product could not be stocked advantageously and economically, and buyers' specifications vary, steel being usually rolled to order. Relief might be suggested in the form of some mills closing entirely and others running at fair rates, but that would increase the hardships of the workmen and the idea is rejected on that basis.

The philosophy of the steel trade therefore is that it has nothing to do but peg along and make the best of the situation. In its present depth the depression cannot last long, it is argued, for the country is certainly using and wearing out steel at a greater rate than the present production of steel, so that some sort of reaction must come soon.

American Leather Chemists Association

IN VIEW of the chemical and physical complexity of materials as well as reactions involved in the production of leather, it is not strange that the development of analytical methods has occupied a very considerable portion of the chemist's attention in this field. The earlier independent workers were confronted with strange inconsistencies when attempts were made to interchange methods and compare data. Quite naturally this led to the formation of groups of chemists in different countries for the purpose of standardizing analytical methods. A brief outline of this evolution as it took place in America may be of interest in connection with the report of the eighteenth annual meeting of the American Leather Chemists Association which will be found elsewhere in this issue.

In attempting to determine the tannin content of certain foreign tanning materials which were exhibited at the Columbian Exposition at Chicago in 1893, WILLIAM H. KRUG became strongly impressed with the need for a uniform method of analysis. The desirability of close co-operation was evident and after considerable discussion the Association of American Leather Trades Chemists was organized in Chicago, Oct. 30, 1893. At the next meeting, which was held in conjunction with that of the Association of Official Agricultural Chemists on Aug. 23, 1894, at Washington, it was decided to become a section of the latter organization. For a time this arrangement was satisfactory, but gradually it became apparent that the interests of the two groups were drifting apart. Accordingly a small group of leather chemists who had been active in the work of the tannin section of the A.O.A.C. met Nov. 3, 1903, and formed the American Leather Chemists Association, which, however, did not assume independent existence until the fall of 1905. At this time the council authorized the publication of a monthly journal and appointed W. H. TEAS editor. The first

issue appeared in January, 1906. The subsequent development of the association was marked by steady growth and broadened interests, and at present it has over five hundred members.

Of necessity, much of the research work done has been of a routine analytical character and many of the methods developed are empirical in nature, requiring strict adherence to the minutest details of manipulation in order to obtain concordant results. Even today, in spite of years of experiment, there is no satisfactory direct method for the determination of tannin. These difficulties are due in large measure to the complex chemical and physical nature of the materials, and it is becoming increasingly evident that their solution will require intensive application of physicochemical principles, colloid chemistry being included within the meaning of this term. Prof. H. N. HOLMES' brilliant address on colloids should be particularly effective in stimulating appreciation of this fundamental subject.

The chemist's first efforts in this industry were looked upon with mistrust by the practical tanner, and it would seem that even at the present time there is in many cases an unnecessarily wide gap between the chemist and the tanner. Thus it was somewhat of a surprise to learn at the recent convention that this was the first time that Tanners' Council had extended a wish for a successful meeting. However, this feeling of astonishment was tempered somewhat by the remarks of L. J. ROBERTSON, vice-president of Tanners' Council, who spoke most highly of the work done by the chemists in the leather industry and suggested consideration of a plan whereby members of Tanner's Council would receive copies o fthe journal of the association.

Although the leather chemists can point with considerable pride to past accomplishments, they show no disposition to rest on laurels already gained and their attitude is rather one of eagerness to push forward into the vast unexplored regions upon which their feet have just begun to tread.

Easy Money From Work

SOME time ago we published an article entitled "Easy Money From Peat." All you had to do was to buy stock and wait for the returns. The investors are still waiting, but so long as they have abundant faith they can enjoy themselves. There is another source of easy money, for detailed information of which we are indebted to the Boston *Herald*. That newspaper published a series of editorials on the building situation in the Hub, and these have been collected and republished in the form of a little book. It tells us how to make good money by joining building trades unions.

For instance in the regulations of the Plumbers' Union of Boston Article 9 reads: "It shall be the duty of all foremen to report any man late on his job to his employer at the time it occurs." That sounds all right, but in labor circles there seems to have entered a quality of talmudic scholarship that qualifies rules, giving them new and unexpected meanings. Another rule requires that all foremen shall be union men and Article 9 has been construed to indicate that a foreman may not report a workman for delinquency in any other respect than tardiness. In the Painters and Decorators' Union it is said that a foreman is restricted from commenting on whether a man is doing a proper or an inadequate measure of work.

In the Plasterers' Union there is a rule that, no matter how many men may be employed in a shop, no more than three apprentices may learn the trade in it. Article 14 in the local Plumbers' Union reads: "It is expressly understood that no employer will be entitled to more than two apprentices."

Among bricklayers it was discovered that apprentices could not be employed unless they were the sons of members of the union engaged on the job. The plasterers have a rule which requires them, when traveling to and from work out of town, to take the train nearest 8 in the morning, and 5 in the evening.

If you can crank a Ford car you can operate a gasoline diaphragm pump, and if you can operate a gasoline diaphragm pump and the union admits it and gives you a card, you are an "engineer." Time was when the water boy who carried kettles of water or beer to the men working on a job used to run half a dozen of them with ease. It wasn't supposed to be skilled work. But now it is, and an "engineer" runs a single pump, getting $10 a day for starting it in the morning, pouring a little oil on it occasionally, and stopping it at night. If he doesn't have to stop the pump at noon and start it up again at 1 o'clock, but can just let it run, then he gets overtime pay for the noon hour.

An instance is given of a building operation in the Back Bay district in which an automatic electrically-driven pump with float control was installed. It was placed in a wooden shack, under lock and key. The union declared that it must be under the constant supervision of an "engineer" and the easy work of sitting outside the shack cost the builders $168 a week.

A hoisting engine needed repairs. The regular engineer was asked to perform the work over Saturday afternoon and Sunday. He refused. The work had to be done and the employer obtained outside men to do it. But the regular engineer received double time for the work done by the outside machinists, even though he refused to do it himself, for the union held that the work "belonged" to the union man.

To build a brick wall cost last year ten times as much as it did a few years ago. The pay of masons was doubled, the work per day per man was cut down from 2,000 bricks a day to 500, and owing to shortage of masons, builders had to bid up from $1 to $1.35 an hour. It was brought out that the mason who picks up a brick and places it in a wall receives as much as the manufacturer does for the same brick, for excavating the clay, molding it, burning it, handling and storing it and all the risk and charges of doing business.

No brush over 4½ in. in width may be handled by a member of the Painters' Union, and sprayers are forbidden.

These are a few, only a very few, of the ways of getting easy money from work brought out in the Boston *Herald* book. We do not offer them as arguments against union labor as an institution. We mention them as sequelæ of a theory to which we lately referred, that opportunity is property. If opportunity is property, we might as well face the fact, and organize our institutions to meet it. The Declaration of Independence claims that every man is entitled to life, liberty and the pursuit of happiness. Such title involves the freedom of opportunity, and this has been our theory of government and of conduct. It has ceased to be our practice in the building trades and, indeed, in many other unionized occupations.

Industrial Alcohol and Prohibition Enforcement

Chemical Industries Protest Against the Volstead Supplemental Prohibition Bill—Lawful Uses of Industrial Alcohol Are Defended—Provisions of Existing Law Are Declared Adequate, but Its Administration and Enforcement Are Denounced

THE Volstead supplementary prohibition bill was vigorously opposed at a protest meeting of the New York Section of the American Chemical Society, held at the Chemists' Club on June 10. The general interest in the subject and the fact that this was the last meeting before the summer intermission were responsible for an unusually large attendance. In the course of his introductory remarks the chairman, Dr. John E. Teeple, said: "I wish to make it perfectly clear that we are not here to discuss prohibition, its advantages or its disadvantages. This is a matter of private opinion and not a subject for action by this organization of chemists. We are not here to discuss the desirability of enforcing the prohibition enforcement act or any other act on the statute books. But the prohibition enforcement act clearly distinguishes between alcohol for industrial use and alcohol for beverage use. We are vitally interested in the first form of alcohol, and as a society are not at all interested in the second form.

Attitude of the Anti-Saloon League

"The enforcement act instructs the commissioner to prevent the use of alcohol as a beverage. This is accordingly his duty. But just as definitely and clearly it instructs him to insure an ample supply of alcohol and promote its use in scientific research, and in the development of fuel, dye and other lawful industries. Consequently this is also a lawful duty of the commissioner. If the commissioner attempts to carry out his proper function in both cases, he will of course at times meet difficulties, and will probably develop a tendency to lean toward one duty at the expense of the other in order to avoid these difficulties. The Anti-Saloon League propagandists can see only prohibition in the law or in the duty of the commissioner. The chemist sees another duty which is just as important and just as much a matter of law; that is the duty of promoting the use of alcohol in the industries.

"I have received a very courteous letter from Wayne B. Wheeler, general counsel of the Anti-Saloon League, in which he states that the announcement of our meeting gives him the impression that some of our members have been misled concerning the provisions of the pending supplemental enforcement bill and that many of those who spoke against the bill in its original form were unduly alarmed about the possible effects of it. The bitter experiences of legitimate chemical firms of long standing who have occasion to use alcohol for legitimate purposes are a matter of record. Some of these experiences and difficulties will be related to you tonight. A little careful thought will indicate that these people, with a continued history of unnecessary interference with their business still fresh in their minds, are not likely either to be misled or to be unduly alarmed. They know what is happening and what will result from the present trend. They have reason to see this situation much more clearly than Mr. Wheeler could possibly see it, and at this meeting tonight the various speakers want to give you a clear picture of the situation as it exists."

The first paper to be presented was that of Dr. Martin H. Ittner, chairman of the industrial alcohol committee of the American Chemical Society.

Report of the Committee on Industrial Alcohol

By Martin Hill Ittner

At the spring meeting of the American Chemical Society in Rochester, Dr. Raymond F. Bacon called attention of the society to the danger threatening the industries of the country if prohibition enforcement legislation is allowed to become enacted without properly providing for the unhampered use of industrial alcohol. A committee on industrial alcohol was appointed to study the subject and represent the society, if need be, before legislative bodies on matters pertaining to alcohol on which there was practically a unanimity of opinion within the society.

The bill, H. R. 5033,[1] which was recently introduced in Congress to amend the national prohibition act, contains features which are unquestionably seriously objectionable to many industries, and the committee on industrial alcohol requested a hearing before the Committee on the Judiciary of the House of Representatives. This request was finally granted and the alcohol committee presented the resolutions of the American Chemical Society and a few specific suggestions for the modification of some of the more objectionable provisions in H. R. 5033.

The resolutions of the American Chemical Society are as follows:

> Whereas the use of alcohol in many important industries is absolutely necessary not only to the continuance of such industries but also for the manufacture of articles needed by other industries and even for the production of articles necessary to the protection of, and sustenance of life itself, and
>
> Whereas it is the policy expressed in the national prohibition act to encourage the use of industrial alcohol for non-beverage purposes, such as the manufacture of thousands of necessary medicinals, and countless dyes, chemicals and perfumes, and for the production of heat, light and power.
>
> *Be it Resolved*, That the American Chemical Society advises, and most strongly urges, for the national welfare, that all legislation for the enforcement of prohibition be so clearly drawn as not to restrict the activities of legitimate industries which must have industrial alcohol, and that all such legislation be so drawn as to provide in specific sections for the encouragement of the proper use of alcohol in the industries.

Limits the Supply and Use of Alcohol

For the benefit of those who are not familiar with bill H. R. 5033, I will say that its ostensible purpose is to control and prohibit the use of beer and light

[1] Editor's Note: H. R. 5033, referred to here, was subsequently amended and reported June 2, 1921, as H. R. 6752. See Chem. & Met. Eng., vol. 24, p. 1076, June 15, 1921.

wines for medicinal purposes, but instead of confining itself to this, as it might have done, it does not even mention beer, but goes on to limit the supply and use of alcohol.

It would not allow any pure alcohol to some of the important industries unless the manufacturer, in each case, could clearly establish to the satisfaction of the commissioner that it would substantially interfere with his manufacture if he used a medicated or compounded alcohol. The burden of proof is put on the manufacturer. He is denied the alcohol at the outset and he *may* get it if he is lucky enough to convince the commissioner. If a manufacturer makes a hundred different articles with the use of alcohol, and some of them make more than that, it will be necessary, in the case of each article, to present a separate argument or the use of pure alcohol will be denied for the manufacture of that article. Respectable, long-established manufacturers are even now subject to frequent and unnecessary delays and hold-ups on their supply of alcohol, and this new bill, if enacted as introduced, would bring about an intolerable condition.

After making it obligatory to "medicate or compound" alcohol, to use the language of the bill, or to denature it, in plain English, a "joker" is introduced which reads, "Liquor, including alcohol, so medicated or compounded shall not be exempted from any tax to which liquor is subject," thereby greatly restricting the use of tax-free denatured alcohol in some of the important industries.

The first glaring defect in the bill, as introduced, to which the committee on industrial alcohol called attention was the power conferred on the commissioner to restrict the supply and uses of alcohol. In the first part of section 2 the bill apparently permits the manufacture of alcohol without restriction as to quantity, but further along in the same section the commissioner is told that he *shall* limit the supply and use of all liquors, *not* excluding alcohol. If he is directed to limit the supply of alcohol, he must necessarily restrict manufacture. He is directed to limit the supply "to the actual needs for non-beverage uses." No commissioner can know the actual needs and he is almost sure to restrict the supply of alcohol so that it will be insufficient.

Amendments Proposed by Committee

The committee proposed an amendment by introducing the words "save alcohol" after "all liquors," line 11, page 2, section 2, so that it would read as amended: "The commissioner shall limit the supply and use of all liquors, save alcohol, to the actual needs for non-beverage uses," etc. It ought to be perfectly evident that the commissioner should not be allowed to restrict the supply and use of alcohol. For instance, he should not be permitted to restrict the supply of denatured alcohol, but if he limited the supply of pure alcohol in accord with his guess as to the actual needs, he would thereby restrict the supply of denatured alcohol; for you cannot have an adequate supply of denatured alcohol if you limit the supply of pure alcohol, as denatured alcohol is made from pure alcohol. The supply and uses of pure alcohol as such for industrial purposes should not be subject to the absolute control of one man.

Section 3 of the bill contains even more objectionable blows at industry. As I have already explained, the bill seeks to force manufacturers to use "medicated or compound alcohol," or, in plain English, *denatured* alcohol, in the manufacture of all articles, and then after this thrust at industry gives the bayonet a final vicious twist by providing that "alcohol so medicated or compounded shall not be exempted from any tax to which liquor is subject."

To meet these objectionable parts of the bill, the committee on industrial alcohol offered an amendment to section 3, cutting out the most objectionable parts and adding an amendment that would not only encourage the proper use of alcohol in the industries but would also tend to prevent much of the diversion of alcohol to unlawful purposes. Section 3, with the amendment proposed would read:

> No other intoxicating liquor than alcohol shall be used in the manufacture of any article enumerated in subdivisions b, c, d, and e of section 4, title 2, of the national prohibition act unless it shall clearly appear to the satisfaction of the commissioner that without considering palatability the use of some other intoxicating liquor than alcohol is essential as a component part of such article; and *in furtherance of the provisions of title 3 of the national prohibition act, tax-free alcohol suitably and lawfully denatured may, under regulations, be used in the manufacture of any such article.*

Use of Tax-Free Denatured Alcohol

Your committee after careful consideration decided they could not take any other ground. If a manufacturer in legitimate business, and we are not considering any other at present, finds that he must have pure alcohol in his work, let him have it under suitable regulations and he will pay the tax that is due on pure alcohol. If he can gradually find suitable denaturants so that in the manufacture of some of his articles he can use alcohol denatured in one way or another, but all unfit for use for beverage purposes, he should then be allowed to use such alcohol tax free. The Government shou'd not hinder him, but should co-operate with the manufacturer in finding new opportunities for the use of denatured alcohols. Each article so made which was previously made with tax-paid alcohol lessens the possibility of alcohol being diverted to beverage purposes. There is no more reason why denatured alcohols used under regulation should be taxed than that coal should be taxed, and there is no reason why any legitimate industry should be denied the use of tax-free denatured alcohol.

Other Objectionable Provisions

The committee on industrial alcohol looks upon all of section 4 of H. R. 5033 as unnecessary and objectionable and requested that it be stricken out entirely. This section provides nothing essential to prohibition enforcement and is unnecessarily obstructive. It provides a delay of not less than twenty days to any permit to sell any liquor, including alcohol, to manufacture alcohol, or to manufacture articles from alcohol such as medicines and the like. It requires the public posting of the fact at one's place of business so that any fanatic may become informed thereof, and then provides a means whereby any fanatic may hold up such a permit and even force a man to go to court to get what the Government ought to aid him in getting at the outset. The provision referred to is as follows: "Any federal or state officer or any person authorized thereto by any such officer may oppose any such

application." It is not unreasonable to suppose that somewhere there might be found an overzealous state officer who would come under the designation of "any state officer," and it is not outside the range of possibility to assume that such a state officer might authorize all his zealous friends to oppose alcohol permits, these zealots answering the description of "any person authorized thereto by any such officer," thereby giving them the authority of law to "oppose any such application" for alcohol.

With respect to the other sections of the bill we made no recommendations, but our silence is noncommittal.

I cannot refrain from giving my impressions with regard to the hearing before the Committee on the Judiciary. At first, it was not at all certain that we would get a hearing, and the chairman evinced a desire from the start to hear as little as possible against the bill. His frequent remarks tended to divert the testimony of the speaker so that he was forced involuntarily from his intended line of argument. I wish to add that some of the members of the committee impressed one as being both intelligent and fair, but it is doubtful whether many of them realize the injury that legislation of this kind would do industry.

Importance of Industrial Alcohol

The future prosperity of the country hangs in the balance as much now as it did during the war; more perhaps, for then with an outside objective we presented a united front and worked together, but now, with war out of the way, we are already beginning to forget the necessities of yesterday, unmindful of what the morrow will bring forth. In war time we were absolutely dependent upon industrial alcohol and on our industries. The same is just as true in times of peace, and we are courting disaster when we encourage obstructive legislation.

A year and a half ago all manufacture was going full speed. Now many lines of business are in a bad slump. Though economic conditions, like foreign exchange and war-inflated prices, not the least of which is labor, are responsible for much of the business depression, a greater factor is the uncertainty that we have to face in legislative matters. With Congress continuously mindful of the needs of American industries we cannot help but prosper. We have faith that they see the need of adequate protection against attacks from without, but let us hope that they will also protect us from the dangers that arise within, like those in H. R. 5033.

Industrial Alcohol and Its Relation to Prohibition Enforcement From the Manufacturers' Standpoint*

By M. C. Whitaker

The chemical profession has cause to be concerned over the present and future status of alcohol for legitimate industrial and scientific purposes. Chemists may well ask such questions as: Why am I unable to get alcohol to continue the manufacture of U.S.P. medicinals, antiseptics, flavoring extracts, perfumes and the infinite variety of daily household necessities requiring pure alcohol in their production? Why is it so difficult for me to get alcohol for scientific use for research and for educational purposes? Why do I have to pay a tax of 1,000 per cent on alcohol used in my industry when we have a fifteen-year old law giving us tax-free alcohol for industrial purposes? What has the prohibition of intoxicating liquors got to do with alcohol for industrial uses and for purposes of national defense?

Let us first clarify our problem, and then possibly suggest remedial measures. The national prohibition (Volstead) act was passed with three principal divisions, or titles: Title I. To provide for the enforcement of war prohibition (automatically replaced by the second section—which became operative on Jan. 16, 1920, the effective date of the Eighteenth Amendment); Title II. Prohibition of intoxicating beverages; and Title III. Industrial alcohol.

Alcohol is defined in the prohibition section of the act as follows:

> The word "liquor," or the phrase "intoxicating liquor," shall be construed to include alcohol, brandy, whiskey, rum, gin, beer, ale, porter and wine, and in addition thereto any spirituous, vinous, malt or fermented liquors, liquids and compounds, whether medicated, proprietary, patented or not, and by whatever name called, containing one-half of one per cent or more of alcohol by volume, and which are fit for use for beverage purposes.

The same alcohol is defined in the industrial alcohol section of the same act as

> The term alcohol means that substance known as ethyl alcohol, hydrated oxide of ethyl, spirit of wine, from whatever source or whatever process produced.

Thus it is, at the very outset of our problem, that law has combined with nature to give a Dr. Jekyll and Mr. Hyde character to one of our greatest chemicals, alcohol.

In the administration of this law, when there is an apparent conflict of language, the prohibition officers appear to work under the injunction usually given to beginners learning to drive an automobile: "When in doubt, push both feet." Prohibition is regarded by them as their first duty, and when in doubt, "stop everything—engine and all."

Legal Interpretations of Prohibition

Narrow rulings under these provisions have led to such ridiculous interpretations as may be illustrated by the following instances:

(1) The general counsels of the telephone company in both Boston and Baltimore advised their clients that the listing of the name "U. S. Industrial Alcohol Co." in the directory would be an illegal act under the prohibition law. The company was obliged to obtain an official ruling from Washington in order that its corporate title might be listed in telephone books.

(2) The prohibition commissioner, under date of March 22, 1921, advised the U. S. Industrial Alcohol Co. that the use of the words "Cologne Spirits and Alcohol, Pure and Denatured" on their letter heads (standardized for fifteen years) was illegal under the prohibition act, and must be stopped. As result of an appeal to the solicitor of the Internal Revenue Department, this ruling was finally reversed under date of May 12.

(3) E. B. Badger & Sons, of Boston, attempted to purchase a copy of "Young's Fractional Distillation" from a local book store, and were advised by a clerk

*Dr. Whitaker was prevented from attending the meeting because of his father's death, and his paper, which is printed here in abstracted form, was read by the chairman, Dr. Teeple.

that they had the book, but that it could not be sold under the prohibition law. On May 6, 1921, the following letter, signed by John F. Kramer, prohibition commissioner, was directed to the firm:

> Gentlemen: Replying to your letter of April 29, 1921, you are informed that if "Young's Fractional Distillation" is a scientific publication which is commonly used by scientists, this office perceives no reason why it should not be purchased by you for the use of your engineering department.
>
> This office issues no permits to enable scientific persons to procure such technical works, but it is anticipated that this letter exhibited to any bookseller who has such a work for sale will serve the purpose.

(4) On May 15, 1920, the U. S. Industrial Chemical Co. of Baltimore delivered to the steamship piers thirty-two drums of iso-butyl alcohol for export to France. The ship's agent refused to accept the goods, because he noted the word "alcohol" on the package and in the bill of lading, stating that they were not permitted under the prohibition laws to handle alcohol.

The goods had to be reloaded, trucked back to the plant, a round trip distance of twelve miles, relabeled and new bills of lading prepared under the name "isobutyl solvent." Under this name the steamship company accepted the consignment and the reason for the disguise had to be explained to the French buyers as well as such a thing can be explained to a chemist of a sister republic.

(5) The Bishop Gutta Percha Co. applied for a permit to use tax-free alcohol in its laboratories. The answer to the application, under date of May 6, contains the following paragraphs:

> This permit is granted on condition that the permittee agrees to keep on hand a stock of tax-paid alcohol for the routine work of the laboratory and that the tax-free alcohol withdrawn under this permit will be used only for original research and development work. When the research work has been developed into an actual working process and the function of the laboratory is merely to continue the operation of this process, tax-free alcohol may not be used.
>
> Routine work such as tests or analyses for purity of various materials both during the process of manufacture and in determining the purity of the finished product does not appear to be exclusively scientific research, and tax-paid alcohol should be used for such purpose.

Attitude of Prohibition Advocates

Wayne B. Wheeler, general counsel of the Anti-Saloon League, made, before the Judiciary Committee, on Friday, May 20, the following very significant statement: "If it comes to the point where it must be a choice between medicaments for medical preparations and the enforcement of the law, I think we must choose law enforcement." Likewise C. R. O'Connor, until recently federal prohibition director of New York, is reported to have said, in answer to a protest by manufacturers in regard to the reluctance of his office to approve permits to obtain alcohol for their industrial operations, "Industrial alcohol be damned; you know it's all booze!" One of the greatest difficulties connected with the separation of industrial alcohol from prohibition enforcement is reflected in these two statements by high authorities in the prohibition-enforcement program. The do-or-die fanaticism reflected in Mr. Wheeler's statement and the utter lack of knowledge as to the existence of an industrial alcohol problem as reflected in Mr. O'Connor's statement represent the frame of mind of 90 per cent of the prohibition advocates.

It is a notorious fact that the Anti-Saloon League dominates prohibition legislation and enforcement. When the prohibition law to enforce the Eighteenth Amendment was presented to the Judiciary Committee by Mr. Wheeler, it consisted of what are now Titles I and II, for the enforcement of prohibition, with absolutely no provision for industrial alcohol. What is now Title III, the industrial alcohol section of the prohibition bill, was drafted and introduced as a Government measure at the direct suggestion of the then commissioner, Daniel C. Roper, in order to save industrial alcohol. It was through the foresight and influence of the officials of the Bureau of Internal Revenue, and not due to any consideration on the part of the promoters of the Anti-Saloon League bill, that the bills presented to Congress to enforce prohibition carried any provision whatever for industrial alcohol.

The entire disregard of the right of existence of alcohol, the chemical, for industrial purposes can only be explained on the assumption that they are totally lacking in knowledge of its essential relations to chemical industry, to their home comforts, to the health of themselves and their families, to the progress of science, and to national defense. Granting this ignorance, it is not surprising that they believe and advocate, as the best method of enforcing prohibition, the complete extermination of all alcohol.

Need for Educational Campaign

This is a condition for which the chemists, in a large measure, are responsible, and a condition which they and the industries using alcohol can and must remedy. They have not adequately educated the public, who make and enforce our laws, in the matter of the essential needs of chemical industry. To educate that public is a big contract, but it must be undertaken and successfully carried through by the chemists working individually and collectively, if alcohol and all industry directly and indirectly related to it is to be saved.

Chemists look upon alcohol as one of the most essential and important materials of their industry. They put it in the same class with sulphuric acid, benzene or caustic soda. They know there can be no great development of chemical industry without alcohol, any more than there could be a steel industry without pig iron, an electric industry without copper, or a fertilizer industry without potash and fixed nitrogen. While alcohol may not be used directly in the manufacture of textiles, automobiles or sugar, any chemist can draw a flow sheet to show its relation to some of the contributing industries.

Furthermore, petroleum experts issued a warning at the last meeting of the American Chemical Society in Rochester in regard to the visible supply of liquid fuels, which ranks in importance with the famous warning of Sir William Crooks in reference to nitrogen for fertilizer. They have pointed out that in from fifteen to twenty years the rapidly diminishing supply of petroleum will compel the world to turn to some other source for liquid fuel. The only possible solution to the problem in this distressingly short time is alcohol.

Division of Industrial Alcohol Created

The industrial alcohol section of the national prohibition act (Title III) theoretically became effective on Oct. 28, 1919, although administrative regulations (No. 61) were not approved thereunder until Jan. 31, 1920, and Feb. 5, 1920. Laws will not administer themselves, and this is especially true of the national prohibition

act. No provision whatever was made by the Government, at the outset, to separate the administration of industrial alcohol from prohibition. All energies were arbitrarily directed, under the ceaseless pressure of the Anti-Saloon League, to organizing for and administering prohibition, while the industrial alcohol provisions of the law were literally lost in the fog.

The situation for alcohol for the industries, for research and for education became so serious that in June, 1920, a large committee representing leading educators, investigators, chemical societies, consumers and producers and the War and Navy Departments journeyed to Washington and strongly protested at the neglect of the legitimate alcohol industry in the scramble to enforce prohibition.

This protest finally resulted, in October, 1920, in the creation of the Division of Industrial Alcohol and Chemistry, under Captain D. S. Bliss, deputy prohibition commissioner, with Dr. J. M. Doran, of the Bureau of Internal Revenue, a chemist of high professional standing and long experience, in charge. This division has not had an opportunity to achieve the full measure of its importance, because it is still subordinated to the prohibition provisions of the law. A Division of Industrial Alcohol and Chemistry, directed by competent chemists equipped with adequate facilities, and charged with the full responsibility of administering all alcohol for industrial, scientific and non-beverage uses, is clearly implied when industrial alcohol was given a separate section of the law, and the legal provisions to "place the non-beverage alcohol industry and other industries using such alcohol as a chemical raw material or for other lawful purpose upon the highest possible plane of scientific and commercial efficiency" are made mandatory.

The chemical profession and the chemical industry should unite to make the Division of Industrial Alcohol and Chemistry what it is legally stated to be, and what the economic future of this country demands that it should be—an organization to control alcohol, the chemical.

New Volstead Bill Threatens Chemical Industries

Let us turn our attention to the new bill now before the House, which is a further encroachment upon chemical industry. The development of industry as a whole is a matter of bread and butter to the chemist; the greater that development the more bread and the more butter will be available to those men who have chosen chemistry or the chemical industry as their profession. New legislation, of which we are threatened with a surfeit, and which threatens chemical industry, deserves the attention of all chemists.

This new bill (H.R. 6752) introduced by A. J. Volstead, chairman Committee on Judiciary, and sponsored by Wayne B. Wheeler, counsel of the Anti-Saloon League, is admittedly intended to prohibit beer, although the word "beer" is not used once in the proposed act.

For purposes of discussion, the bill may be divided into three parts: (1) The prohibition of beer, and limiting prescriptions; (2) the extension of governmental control, under the guise of prohibition, to the U.S.P. medicines, the proprietary, the perfume and the flavoring extract industries; (3) the penalties.

We as a profession are not concerned with the prohibition features of this bill. It might be fair to assume that our professional associates, the medical men, would wince at the idea of having the judgment of a commissioner of prohibition supersede that of the 150,000 medical practitioners in the United States.

Government Control Is Extended

The proposal to include under this bill a group of industries conforming in every respect to the provisions of the Eighteenth Amendment, the national prohibition act and every other law of the land is plainly an effort to extend government control where it is neither necessary nor desirable.

Your home town laws used to require a man who proposed to open a saloon in a neighborhood to post a notice of his intention upon the doors and walls of the building, in order that the whole neighborhood might be advised of the impending stigma that was about to be placed upon it and have an opportunity to work up opposition.

Similarly, the pending bill, in the case of a manufacturer proposing to engage in the business of making pharmaceutical, proprietary, toilet and antiseptic articles or flavoring extracts, requires that "notice thereof shall be served on the Attorney General and publicly posted at applicant's place of business" . . . and further, "any federal or state officer or any person authorized thereto by any such officer may oppose any such application." Why should a legitimate chemical industry and its owners and employees be stigmatized and put in the class with the corner saloon or the bootlegger, and the clear implication held out that he is engaged or is about to engage in a business of questionable character? Why should legitimate business plans be disclosed by "notice of intention," and why should another opportunity be created, by law, for graft?

Another provision of the bill gives concurrent power to the Commissioner of Internal Revenue and to the Attorney General, and also provides that the Attorney General may designate "some suitable person or persons to have charge of and perform the duties imposed upon him by this act."

This means, in plain English, that these legitimate industries, because they require and use alcohol, will have to submit their business, their operations and their employees to control, not only by two independent Government departments, but also by an additional unknown quantity designated as "some suitable person or persons." Who do you think it or they will be? The risks of doing business under such conditions would alienate legitimate investors.

Stigma on Chemical Profession

No chemist could afford to risk a fine of $1,000 or a jail sentence for five years for some alleged or technical violation of the law. Such provisions as these stigmatize an important division of chemical industry, and that stigma passes to the chemical profession as a whole. Successful enforcement of prohibition requires the co-operation of the chemists to a greater extent than that of any other profession, and that co-operation can not be obtained by wholly unnecessary or misdirected stigmatization.

Does the spirit of the proposed bill conform to the principle of placing "the non-beverage alcohol industry and other industries using such alcohol as a chemical raw material, or for other lawful purposes, upon the highest possible plane of scientific and commercial efficiency" as already provided in the industrial alcohol section of the existing prohibition enforcement law?

Relation of Industrial Alcohol to Pharmaceuticals, Perfumery and Flavoring Extracts

W. L. Crounse of Washington, the counsel for the National Wholesale Druggists Association and the Manufacturing Perfumers Association, told of the interesting experiences of these industries with prohibition enforcement. Former Prohibition Commissioner Kramer was quoted as authority for the statement that of 75,000 permits issued during the first year of prohibition, 12,000 at least were issued to persons who had never before been engaged in any line of industry in which alcohol was used. Over 4,000 of these were issued in New York City alone, and it can be safely estimated, according to Mr. Crounse, that five of every six of these were used illegitimately. "These fly-by-night concerns either diverted their alcohol to beverage purposes without pretending to manufacture a legitimate product, or mixed it with some bland essential oil, a little coloring matter and a small amount of sugar, and 'bootlegged' it through low-grade barber shops under 'hair tonic,' 'face lotion' or similar labels."

One of the most demoralizing phases of prohibition enforcement, according to Mr. Crounse, has been the character of the organization charged with its administration. Protests of honest dealers and manufacturers have often been unheeded by prohibition directors, but "intimations were frequently received to the effect that if anyone who had difficulty in obtaining a permit would apply to certain ex-officials of the prohibition unit, relief would be speedily forthcoming." A number of illustrations were cited to show the graft and criminal laxity on the part of enforcement officials.

Perfumers Forced to Supply Formulas

Many difficulties have been experienced by the legitimate perfumers and manufacturers of toilet articles.

One of the best-known manufacturers of toilet goods in the country was called upon by the local prohibition director for the complete formulas by which his goods were manufactured. As the existing regulations did not require such data to be submitted, the manufacturer was very reluctant to comply with the director's demand, but finally submitted quantitative formulas. A fortnight later he was greatly surprised at receiving a second demand for the same data and upon investigation learned that all the formulas originally submitted had disappeared from the director's files. These formulas have never been recovered."

Flavoring Extract Manufacturers Protest

F. M. Boyles of Baltimore stated that the Flavoring Extract Manufacturers' Association was unalterably opposed to the additional restrictions on lawful industry such as would be imposed by the enactment of the Volstead supplemental prohibition bill. Sections 3, 4 and 5 were declared to be the most objectionable to the food industries.

"The first sentence of section 3 gives the prohibition commissioner the arbitrary power to grant only such permits as are necessary to supply the actual needs for non-beverage purposes, and to limit the supply and use of all liquor save denatured alcohol and denatured rum unfit for internal use to such non-beverage needs. This is an entirely unnecessary provision, because the Volstead act itself determines that there is no use or need for alcohol save for non-beverage purposes.

"In section 4 we manufacturers are classed with the corner saloonkeeper, and required to post publicly in our places of business notice that we have applied to the prohibition commissioner for a permit to use alcohol in our business, and anyone in the community who may have a personal grudge against us or any federal or state officer who is looking for graft can oppose our application. We object to notifying anybody how, when or where we purpose to use alcohol.

"Section 5 gives concurrent authority to the Attorney General and to the prohibition commissioner to suspend or cancel a permit. The result of this would be to subject the manufacturer to the decisions of two tribunals instead of one. In decisions pertaining to business, we believe that only one department of the Government should have such authority."

Legal Status of Industrial Alcohol Explained

The concluding speaker, Alfred D. Van Buren, general counsel of the legal division of the Bureau of Internal Revenue, was introduced by the chairman as one of the Government officials who has been most helpful to the legitimate users of alcohol. In referring to the legal status of industrial alcohol, Mr. Van Buren said:

"Industrial alcohol is absolutely no different, whether it is the pure alcohol designated in the definition of Title I as a liquor, or whether it is used industrially and chemically under Title III. It is the same product which Congress has classified within the term of "intoxicating liquor," but bear in mind that the Eighteenth Amendment was simply for the prohibition of intoxicating liquor *for beverage purposes.*

"Congress recognized the fact that there was a legitimate use and value for all liquor, and consequently provided for the non-beverage use of liquors, including alcohol. The non-beverage industry is a general or descriptive term, but the industrial use of alcohol, and the use of alcohol as a chemical is, without the slightest doubt, a non-beverage use. It is therefore not prohibited by federal amendment nor by the national prohibition act.

"Alcohol as booze or liquor has no legal status, but alcohol as a chemical has a legal status which must not be disturbed, but on the contrary, promoted and encouraged."

The proper extension of the policy of denaturation was emphasized by the speaker as one of the ways in which the chemist can increase the usefulness of alcohol without coming into conflict with the operations of the prohibition act.

"The only thing that stands in the way of the open door for denatured alcohol is the question of taxes. I have tried to explain that the tax on intoxicating liquors was for the purpose of collecting revenue and for stamping out a malicious commodity. If, therefore, by denaturation you can destroy the intoxicating character of alcohol as a liquor, you are certainly solving one of the great problems of prohibition, for the records at Washington show that 90 per cent of the alleged liquor seized consisted of diverted alcohol, or alcohol which has been converted into spurious liquor and medicinal compounds.

"I believe that if prohibition, as incorporated in the Eighteenth Amendment of the Constitution, was again submitted to the people, it would carry overwhelmingly; but I do not believe that this prohibition contemplates or means that the legitimate non-beverage industry, represented by industrial alcohol or by the use of alcohol as a chemical, was ever intended to be disturbed by the people of this country."

American Leather Chemists Association, Atlantic City Meeting

Committee Reports—South America and the Leather Industry—Synthetic Tanning Materials—Explosiveness of Tannery Dusts—Chestnut Wood Tannin—Conditions in Leather Industry—Colloids —Tanning Materials in the Far East

THE eighteenth annual meeting of the American Leather Chemists Association was held at the Hotel Ambassador, Atlantic City, June 9, 10, and 11. Over one hundred members attended and many took active part in the discussions which followed the presentation of papers. In the following report no attempt has been made to cover any of the papers in detail, since they have been or will be published in full in the journal of the association.

Opening Remarks

In opening the meeting the president, F. H. Small, reviewed the work of the association during the year. In order to relieve the financial condition of the society it became necessary to increase both dues and advertising rates in the journal. The results of this step have been most encouraging, as only thirty members have resigned since the dues were increased and only seventeen of these gave the increase as the specific reason for resignation. The May, 1921, journal shows an increase of 50 per cent in amount of advertising compared with the May, 1920, issue in spite of the higher rates.

Turning to the subject of research, Mr. Small pointed out that the association was built upon committee work which is research directed toward the establishment of uniform control methods. That the British and German organizations of leather chemists are working with renewed vigor is evident from a perusal of their respective journals. During the year the American Leather Research Laboratory, which had been maintained at New York under the auspices of the Tanners' Council for the past three years, was removed to the University of Cincinnati and placed in charge of George D. McLaughlin, a well known-member of the association.

While the year had presented many unusual problems to the leather chemist Mr. Small expressed the opinion that the tide had turned and that the day of wasteful and extravagant production had passed.

In his report as secretary-treasurer, H. C. Reed stated that on June 1, 1921, the association had 177 active, 230 associate and 99 mutual members—a total of 506.

Effect of Humidity on Moisture Determinations

F. P. Veitch read a paper by T. D. Jarrell on "The Effect of Atmospheric Humidity on the Determination of Moisture in Leather." These experiments were undertaken in an effort to account for the difficulty of checking moisture determinations. Analyses carried out at one constant relative humidity were compared with those made at another humidity. It was found that drying at a lower relative humidity gave consistently higher results. As an example, the average of four determinations of total solids in a chestnut wood extract was 93.09 per cent at 65 per cent relative humidity and 93.60 per cent at 30 per cent relative humidity.

Soaking and Liming Hides

C. M. Morrison treated the subject of soaking and liming hides in a most instructive and interesting manner. He discussed the problems which confront the tannery superintendent and gave practical suggestions for the successful conduct of these important steps in the preparation of hides for tanning.

South America and the Leather Industry

Personal observations formed the basis of G. A. Kerr's paper on "The Relation of South America to the Leather Industry." In order to avoid the possibility of drawing erroneous conclusions from abnormal war conditions, the review was based rather on prewar figures.

Hides and Skins. Of the eleven South American countries, nine raise cattle and export hides and skins. As a hide producer Argentina takes first place in the world. The establishment of the frozen meat industry in 1877 gave a great impetus to cattle raising, Argentina being the first country to ship frozen beef. In 1913 Argentina had 29,000,000 cattle with an annual volume of 4,000,000 hides available for export, two-thirds green salted and one-third dry. During recent years foot-and-mouth disease and anthrax have become prevalent. Argentina also had 80,000,000 sheep in 1913, these being raised primarily for their wool.

Brazil ranks next, although progress will probably be slower owing to the difficulty of securing suitable

grazing land and to the presence of ticks. It is claimed that there are 37,000,000 cattle, but as the population is 27,000,000 (compared with Argentina's 9,000,000) only 2,500,000 hides are available annually for export.

Uraguay resembles Argentina, although developments are naturally on a smaller scale. There are about 7,750,000 cattle and 11,000,000 sheep.

The other countries figure less prominently in the world's leather market, but the total from all of South America is about 15 per cent of the world's consumption of hides.

Tanning Materials. Argentina, Paraguay, Venezuela and Colombia are important producers of tanning materials. Here again Argentina leads with twelve plants having a capacity of 125,000 metric tons of solid quebracho extract. Paraguay has five plants with a capacity of 50,000 metric tons. Owing to labor conditions the maximum capacity has never been attained. Thus in 1914 exports of quebracho extract amounted to 80,000 tons from Argentina and 11,000 tons from Paraguay. The quebracho forests, which were described by Mr. Kerr in the April issue of the journal of the association, are ample for seventy-five years. In Brazil the industry is still undeveloped, but the other countries seem to be able to meet domestic requirements.

Leather. Almost every town has a little tannery, although the demand for leather is not very great, since two-thirds of the population never wear shoes. Not over $10,000,000 gold is spent abroad annually for leather goods. Although workers have become unionized and wages have increased, the greater part of the demand will be met from domestic manufacture. The development of any extensive industry would require outside capital, which will not be readily available until government and finance are stabilized and export duties abolished.

Sampling and Preparation of Leather for Analysis

Results of an exhaustive study of sampling and preparation of leather for analysis were given by F. H. Small. Sides of leather were divided into sections and each section was analyzed for hide substance. As would be expected, the sections near the tail gave higher figures than those near the belly and shoulder. A careful examination of these results showed that it was possible to get two or at the most three samples, each 2 x 8 in., which would be representative of the standard cuts of leather such as backs, bellies, bends, sides, and shoulders. A chart was prepared giving the relative location of the samples to be taken for each cut.

Synthetic Tanning Extracts

Some points to be considered in the application of synthetic tanning extracts were discussed by J. B. Hill and G. W. Merryman. The time of tanning can be reduced by the use of more concentrated baths only if the rate of diffusion can be increased. This result may be obtained in many cases through the application of syn-tans. For success the hydrogen-ion concentration must be controlled and the quality of the syn-tan must be high and uniform. There are two classes of syn-tans, those which act as real tans and may be used alone, and those which must be used with other tans. Neradol D and the cresolsulphonic acid-formaldehyde condensation products belong to the first class, although it is better to use them in conjunction with vegetable tanning materials. When applied in this way, they act as accelerators or drivers for the vegetable tans, produce a tougher leather with a smoother grain, contribute to the tanning action and exert a clarifying influence on the extract and a bleaching effect on the leather.

Syn-tans may also be used as deliming and plumping agents in the preparation of hides.

For sole leather, syn-tans may be added at several points in the process: In deliming, directly in the rockers, in the retaining wheel, with the bleach or filler, in the oil wheel or with the dope.

In discussing the paper C. R. Oberfell suggested that the antiseptic action of these materials might cause sterilization all through the yard. He also stated that experiments led him to believe that the sulphonic acids had no plumping action when freed from excess sulphuric acid. This contention was disputed by Dr. Hill.

Explosiveness of Tannery Dusts

Attracted by the grain-dust explosion investigations in progress at the Bureau of Chemistry, Ralph W. Frey had tests made of the explosiveness of tannery dusts. Those examined were found to explode vigorously when suspended in air and it was planned to demonstrate this property to the members of the association. Unfortunately the conditions prevailing in the convention room made this impossible. In view of recent disastrous explosions in the finishing department of an aluminum ware plant and in pulverizing hard rubber, Mr. Frey thought it wise to direct attention to the possibility of similar explosions in tanneries unless proper precautions are taken[1].

Extraction of Leather

The committee report by John Arthur Wilson on "The Determination in Leather of Matter Extractable by Water" was published in the May journal of the association, and in Mr. Wilson's absence the conclusions and discussions were read by G. W. Schultz.

The subject was also considered by F. P. Veitch and R. W. Frey, battery extractors of the Soxhlet type being used. The effect of repeated extractions at various temperatures was studied. In no case was an absolute end point obtained, although after the second or third period the amount extracted settles to a low, fairly constant value. This may be due to the presence of some slightly soluble substance, or to hydrolysis, but it is not due to the decomposition of hide substance or collagen.

Observations on Wilson-Kern Method of Tannin Analysis

Further observations on the Wilson-Kern method of tannin analysis[2] were made by G. W. Schultz. As a result of several sets of experiments, Mr. Schultz maintains that while the official method may not be fully accurate, the error is not large and is lower than the true value, rather than higher as indicated by the Wilson-Kern figures.

Chestnut Wood Tannin

The characteristics of chestnut wood tannin were outlined by R. W. Griffith. The function of tannin in plant physiology is but little understood. Tannin is obtained

[1] See CHEM. & MET. ENG., vol. 23, No. 19, pp. 915-920, Nov. 10, 1920; vol. 24, No. 1, pp. 29-32, Jan. 5, 1921; vol. 24, No. 11, pp. 473-475, March 16, 1921; vol. 24, No. 17, pp. 737-740, April 27, 1921.

[2] See *J. Ind. Eng. Chem.*, 1920, vol. 12, p. 465; *J. Amer. Leather Chem. Assoc.*, 1920, vol. 15, p. 64; CHEM. & MET. ENG., vol. 23, p. 613, Sept. 29, 1920.

commercially from practically every part of the plant —roots, bark, wood, leaves and fruit. In chestnut wood the tannin exists in the pores or ducts which separate the fibers. It is present probably as a glucoside and the percentage of glucose is quite characteristic of this material. The glucose is not absorbed by the hide powder and is included under non-tannins in the analysis. Nevertheless it supplies acetic acid by fermentation during tanning and should thus be considered as a valuable constituent of the extract. It might also be possible to convert the glucose into lactic acid, which would be of even more value in the bath.

Conditions in the Leather Industry

L. J. Robertson, vice-president of the Tanners' Council and chairman of the committee on the tanning school, said that conditions were about all that the leather industry had today, so that viewing conditions from the schoolboy's standpoint the industry might be said to have flunked. The attitude of Secretary Hoover is encouraging, however, particularly in regard to extending credits to foreign trade for the purpose of helping the export business. The duty on raw hides and skins, which seems to be demanded by the agricultural interests, was declared unsound, since 40 per cent of the raw material for the leather industry is imported.

A better spirit of co-operation between seller and customer is noted and the feeling of hopelessness is passing away. This is fortunate for the industry, since it is very difficult to operate tanneries on a hand-to-mouth basis with rapidly changing styles.

In preparing to meet foreign competition, the tanners have encouraged research, established a tanning school and made studies of such problems as cost accounting methods, elimination of grubs and ticks, etc.

Mr. Robertson is of the opinion that tanners generally should have the benefit of the work done by the A.L.C.A. and he suggested that Tanners' Council should consider some plan by which dues would include a subscription to the journal of the A.L.C.A.

Colloids

Prof. H. N. Holmes of Oberlin delivered a most instructive and entertaining address on "Colloids." The chemistry of colloids is the chemistry of very small things—that is, particles having the dimensions of a few hundred molecules. Bancroft prefers to call it the chemistry of grains, drops, bubbles, filaments and films with at least one dimension very small. Examples of the different types of colloidal suspensions were exhibited and passed around for inspection.

A property of colloidal suspensions which attracts immediate attention is their stability, which is found to be influenced by several factors: Brownian movement, the electric charge carried by the particles, protective films formed by substances such as gelatine or glue, which are consequently called protective colloids; viscosity, equal density in the two phases.

Colloidal suspensions may be prepared in many ways. Grinding is sometimes employed, but one of the most usual methods is peptization. This phenomenon takes place when glue is treated with water, for example. The glue does not dissolve to form a molecular solution, but is merely peptized (or subdivided) into aggregates of molecules. Silver bromide can be precipitated in a coagulated form only when exact equivalents of $AgNO_3$ and KBr are taken. The slightest excess of either results in the formation of a colloidal suspension due to the adsorption of silver or bromide ions as the case may be. This is known as preferential adsorption of ions.

There are two general types of colloids—suspensoid and emulsoid. The former are very sensitive to added salts and give solutions having practically the same viscosity as the solvent used. Thus a 20 per cent suspension of precipitated chalk in water has practically the same viscosity as water. Emulsoid colloids are not sensitive to the addition of salts and yield viscous solutions or gels. Thus a 1 per cent sodium stearate suspension is solid.

Many interesting examples of gels and emulsions were shown and explained. One particularly striking observation was that precipitated silica is ⅔ air by volume, whereas calculations show that there would be only 24 per cent air space if the particles touched. It is evident that the particles are not in contact, which accounts for the free flow observed in these very fine powders.

Tanning Materials in the Far East

Dr. Lloyd Balderson told of his experiences in search of tanning materials in China and Japan. The per capita consumption of leather in these countries is small, the Japanese wearing wooden shoes and the Chinese for the most part none at all. China does, however, produce some hides and skins for export and some leather is made in certain districts. Tanbark is unknown and smoke or mineral tannage is employed as a rule, although in Manchuria fermented milk is used in a manner similar to oil tannage. There are a few modern tanneries in the Canton district making black upper leather by the one-bath chrome process, using tanning materials imported from America.

Wattle and quebracho are imported into Japan and in a search for suitable domestic supplies of tanning materials, the speaker examined the bark from twenty-five species growing in northern Japan. Several of these were found to offer possibilities.

Other Committee Reports and Papers

Dr. Thomas Blackadder's report of the findings of the committee on "Color Measurement of Vegetable Tanning Solutions" having been published in the May journal of the association, he merely summarized the results of the comparison of the Hess-Ives tint photometer with the Lovibard machine.

Other committee reports and papers presented during the convention were "The Estimation of Oils and Greases in Leather," by F. P. Veitch; "The Sugar Content of Leather," by J. S. Rogers; "Post-Mortem Changes in Fresh Hides," by G. D. McLaughlin; "Plumping Power of Tan Liquors," by A. A. Claflin; "Available Calcium Oxide," by F. P. Veitch and T. D. Jarrell; "Rapid Washing of Chromed Hide Powder," by R. W. Frey and L. D. Clarke; "Determination of Epsom Salts," by R. W. Frey.

Executive Session

President Small read the invitation extended to the Society of Leather Trades Chemists to send representatives to the meeting and the reply from the president, J. Gordon Parker, announcing the bi-annual conference to be held in London during the first week in September. Mr. Small also stated that a recent book of Josef Jettmar on "Eisengerbung" had been dedicated to the A.L.C.A. G. D. McLaughlin and G. W. Schultz were elected members of the council.

Recent Progress in High-Frequency Inductive Heating*

Notes on Design, Operation, Melting Rate and Power Input of Electric Furnaces Using High-Frequency Inductive Heating—Most Pretentious Furnaces Yet Constructed Are Melting Precious Metals at the United States Mint and for a Leading Silver Broker

BY E. F. NORTHRUP
Vice-President and Technical Adviser, Ajax Electrothermic Corporation

FURNACES for melting practically all metals and also glass and refractories by means of high-frequency currents[1] have been designed, built and sold:

(*a*) High temperatures and vacuum type furnaces.
(*b*) "Electric crucible" type furnaces.
(*c*) Mint type furnaces.
(*d*) Heat-treatment furnaces.
(*e*) Graphitization furnaces.
(*f*) Miscellaneous heating and muffle type furnaces.
(*g*) Large tilting and pouring-type furnaces.

It is obvious that if the available power is limited to a definite maximum by the capacity of the transformers and condensers supplied, the highest temperature can be obtained only by restricting the volume of the mass to be heated.

HIGH-TEMPERATURE AND VACUUM FURNACE

The highest temperatures may be obtained with a furnace energized with a standard 20-kw. high-frequency converter set when patterned after the standard high-temperature furnace shown in Fig. 1.

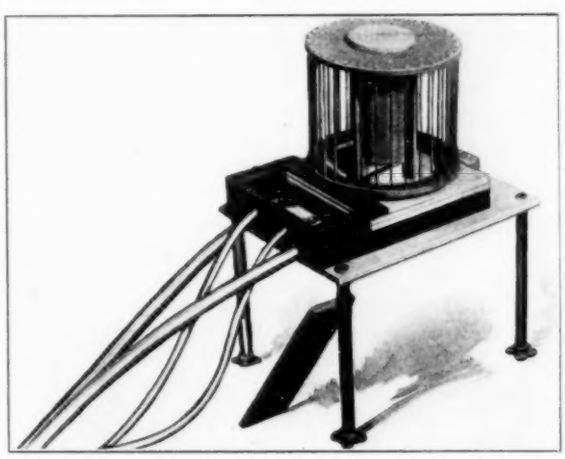


FIG. 1. STANDARD D-1 MODEL

The inductor coil of this furnace is made of forty-two turns of $\frac{3}{8}$-in. (1-cm.) flattened copper tubing. The inductor is wound as a solenoid and is 9 in. (23 cm.) long and $4\frac{1}{8}$ in. (10.5 cm.) in inside diameter. The high-frequency potential is applied to the terminals of this solenoid and also a water pressure of 30 lb. (13.7 kg.) or more, which maintains a flow of water through the flattened tubular solenoid. The furnace may be used as a vacuum or as a non-vacuum furnace. It is of the non-tilting type, and its contents are removed through the bottom by withdrawing a slide of asbestos board. This type of furnace under favorable conditions will melt molybdenum and can be used to melt electrolytic iron in 5- to 6-lb. (2.3- to 2.7-kg.) lots strictly carbon free. The furnace is very suitable for the recovery of platinum scrap. When a crucible of carbon or Acheson graphite $2\frac{1}{4}$ in. (5.6 cm.) inside diameter by 7 in. (17.5 cm.) long is used, and this is heat-insulated with lampblack, it is not difficult to obtain temperatures in from fifteen to twenty minutes which are more than sufficient to completely graphitize carbon.

For melting in vacuum, a quartz tube closed at the bottom is used which just fits the coil. This tube is fitted at the top with a water-cooled cover with a connection for exhausting the air. Refractories insulate better under high vacuum conditions, and the highest temperatures are easily obtained in vacuum with an expenditure of 10 or 15 kw.

"ELECTRIC CRUCIBLE" FURNACES

This type of furnace has been constructed in four sizes. The inductor coil and crucible are conical. The furnace sits upon a low table and makes contact with the high-frequency converter terminals by means of two metallic feet.[2]

All furnaces of this type are designed for pouring the metal contents in the same manner in which the contents of an ordinary crucible are poured, over its edge; hence the term "electric crucible." An "electric crucible" may be lifted by handles, placed on two opposite sides, entirely off the table and poured; or it may be pivoted, around an axis passing through its pouring spout, on trunnions. In this case it is lifted by a handle on the side in the back, and poured.

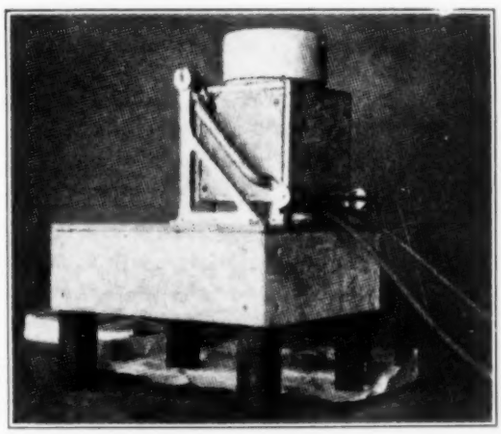


FIG. 2. SIX-INCH "ELECTRIC CRUCIBLE"

*A paper presented at the thirty-ninth general meeting of the American Electrochemical Society, held at Atlantic City, April 21-23, 1921.

[1]See CHEM. & MET. ENG., vol. 20, p. 381 (April 15, 1919) and vol. 21, p. 258 (Sept. 1, 1919).

[2]Described in detail in CHEM. & MET. ENG., vol. 24, p. 309 (Feb. 16, 1921).

Fig. 2 is a view of a 6-in. (15-cm.) "electric crucible." This one either can be tilted around the axis supported by trunnions, or it may be lifted by the handles on its side, entirely off the table, and poured. If it is remembered that all types of furnaces operated by high-frequency induction are substantially at room temperature on the outside, the practicability of handling a furnace in these ways is readily seen.

This particular style and size of furnace is well adapted to melting precious metals, especially gold and platinum alloys. The furnace will melt and pour about 10 to 15 lb. (4.5 to 6.8 kg.) of copper, or about 8 to 10 lb. (3.4 to 4.5 kg.) of steel. The melting is extremely rapid, and when non-conducting crucibles are used, as would be the case when melting a platinum-gold alloy or a ferrous metal, the molten metal stirs violently—a circumstance which assures the perfect mix of an alloy.

Fig. 3 is a cross-sectional view of an "electric crucible" in which the crucible is about 10 in. (25 cm.)

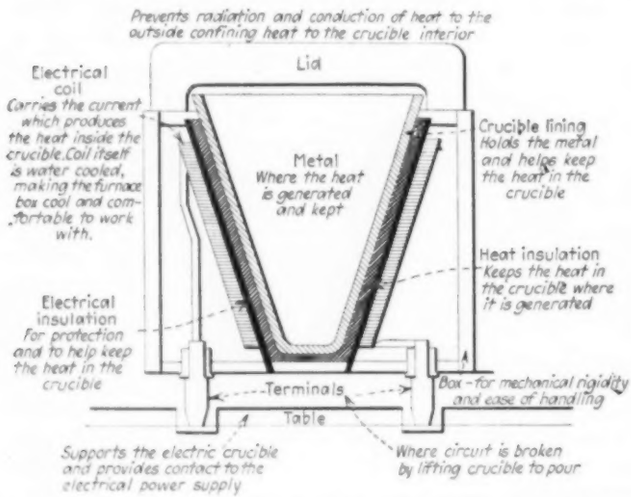

Prevents radiation and conduction of heat to the outside confining heat to the crucible interior
Lid
Electrical coil
Carries the current which produces the heat inside the crucible. Coil itself is water cooled, making the furnace box cool and comfortable to work with.
Crucible lining
Holds the metal and helps keep the heat in the crucible
Metal
Where the heat is generated and kept
Heat insulation
Keeps the heat in the crucible where it is generated
Electrical insulation
For protection and to help keep the heat in the crucible
Terminals
Box—for mechanical rigidity and ease of handling
Table
Supports the electric crucible and provides contact to the electrical power supply
Where circuit is broken by lifting crucible to pour

FIG. 3. CROSS-SECTION OF 10-IN. "ELECTRIC CRUCIBLE"

in diameter at its top. It is designed to hold and melt about 50 lb. (22.7 kg.) of copper or brass and about 25 lb. (11.4 kg.) of steel. In this case a pour is made by lifting the "electric crucible" clear off the table on which it rests. The crucible is lifted and tilted for pouring by two persons, using detachable handles.

Twenty pounds (9.1 kg.) of chromium steel has been melted in a non-conducting crucible from steel turnings (hence the carbon content of the steel has not been changed) requiring 15 kw. and fifty-five minutes, starting with the furnace cold.

For melting pure platinum and iridium free from all contamination, an "electric crucible" has been made with a conical crucible 5⅜ in. (13.4 cm.) in diameter at its top. This conical crucible is made of molded silica ware. Fitting in this is the crucible proper, which holds the metal to be melted. This crucible can be molded of such suitable materials as lime, electrically shrunk magnesia, or the like. The purpose of the outside quartz crucible is to give perfect electrical insulation between the conical inductor coil and the metal contents of the crucible. The melting is, of course, produced by the currents which are generated by the inductor in the metal itself.

In using the above three "electric crucibles," in which it may be required to obtain very high temperatures, it has been found advantageous to maintain a flow of water through the inductor coil. The water connections to the coil are made with rubber tubing a meter or more long, and it has been found that the resistance of this length of water column is sufficiently high to prevent the water circuit from acting as a shunt on the electric circuit.

A larger "electric crucible" without water connections and with a practically cylindrical crucible is, at the date of this writing, under construction. It is designed for melting and pouring brass or bronze in 200-lb. (91-kg.) lots. To secure more rapid melting, a 25-kw. high-frequency single-phase converter set will be used. As this type is a very recent development, performance data are not yet available.

In the 6- and 10-in. (15- and 25-cm.) "electric crucibles" copper melts and superheats to a suitable pouring temperature at the rate of about 4.2 lb. (1.9 kg.) per kw.-hr. As will be shown later, the melting rate with larger furnaces and more power is very considerably increased, 25 per cent or more.

MINT TYPE FURNACES

The Mint type of furnace was designed specially for use at the United States Mint in Philadelphia, Pa., in connection with work carried on in the deposit melting room.

Four furnaces of the same general type have been installed at the Mint for over a year, and two of these "have been operating daily since March 20, 1920, on small deposits, two small crucibles being used to each furnace, which practice has been followed on combustion furnaces for years past."[1] The other two furnaces have more recently been put into continuous operation. "The results of a test run, melting fine silver bars, were as follows: Total amount melted, 13,478.50 oz. (382,115 g.); total time consumed, seven hours; total current used, 156.50 kw.-hr.; pounds melted per kw.-hr., 5.905 (2.68 kg.); average load per phase, 12½ kw. The results will be greatly improved when the capacity of furnaces is reached by having a full quota of condensers (which are now being installed) using 16 kw. per phase instead of 12½. The fuel cost at the rate of consumption shown above compares favorably with gas."[1]

These furnaces are cylindrical, stationary furnaces and are designed for melting metals in a crucible which may be lifted out of the furnace and poured. In the larger furnaces the molten metal is dipped out until only a little remains in the bottom of the crucible. This last portion of metal is removed by then withdrawing the crucible and pouring it out. In the smaller furnaces the metal deposits are placed in small crucibles and lowered into a thin-walled graphite crucible within the furnace, which remains permanently in the furnace.

The four furnaces of this type installed at the Mint use a total of 48 kw.

Fig. 4 is a cross-sectional view of one of the two smaller furnaces which is used exclusively for melting down precious metal scrap in small crucibles.

In the 1920 report of the Director of the Mint, on page 20, a very favorable comment is made on these furnaces and it is there stated that their adaptation to Mint work on precious metals is advantageous.

FURNACE CRUCIBLES—COATED CRUCIBLES

In high-frequency induction heating of ferrous metals and other metals of high resistivity, as platinum, non-conducting crucibles are used. In melting gold, silver,

[1] Annual Reports Director of the Mint (1920), p. 19.

copper and other metals which do not tend to take up carbon at a high temperature it is better to employ a machined graphite crucible or a molded carbon crucible.

The single objection to these crucibles has been due in the past to the rapidity with which they oxidize and burn away at high temperatures when exposed to the air.

To overcome this defect the writer made a research to find a coating which could be put upon graphite or carbon that would have the following properties:

(*a*) It must withstand a temperature of 2,000 deg. C. at least.

(*b*) It must be impervious to air at this temperature, at least to the extent that the graphite shall not oxidize beneath the coating and cause it to scale off.

(*c*) The coating must have a chemical union with the carbon to make it cohere to the carbon tenaciously.

(*d*) It must be of a nature such that other coatings of the same or other material may be laid over it, and cling tightly. This second coating should be capable of selection such that molten metals, even steel, will not dissolve it.

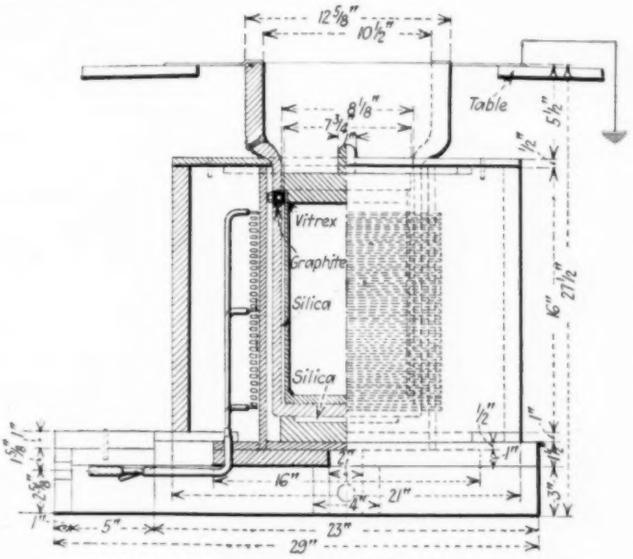


FIG. 4. CROSS-SECTION OF SMALL MINT FURNACE

These results have all been secured. A graphite crucible thus coated will not oxidize when it is at a temperature of 1,800 deg. C. and a jet of oxygen is steadily blown upon it.

The foundation coating is put on at a temperature exceeding 2,200 deg. C. An additional coating of zirkite, magnesite, etc., may easily be added as desired.[1]

These coated crucibles are particularly useful in the "electric crucibles" which may be operated with the cover removed, and the coated crucible freely exposed to the air when hot. These coated crucibles, however, have been made too recently for working life tests with them. It is to be expected that they will have a prolonged life which will make the crucible cost for high-frequency induction furnaces very low.

[1]At the meeting where this paper was read Dr. Northrup gave some information on the method of making these coatings. He first applies directly to the carbon or graphite surface a thin layer of alundum; then over this a layer of carborundum with a little silica. He next introduces a core composed of one part Acheson graphite to 3.5 parts of carborundum sand and packs it in hard. The lining is then "baked" at 2,050 deg. C., bringing up the temperature gradually. During this operation silicon vapors distill off and burn with a flame almost 2 ft. long. It is important not to heat the crucible above 2,050 deg., as otherwise it will be decomposed and destroyed. On the other hand, if not heated high enough, the lining will not be serviceable. Aluminum oxide, Al_2O_3, will wet graphite at a shade over the melting point of the oxide.

Heat-Treatment Furnaces

Heat-treatment furnaces cannot here be described further than to state that steel of any shape, even thin knife blades, or such commercial products as the cutting knives of lawnmowers, when placed in an inductor coil energized with current having a frequency of 20,000 cycles, is rapidly and uniformly heated to the proper quenching temperature. The heating in this case is due largely, and in the case of thin steel sheets almost wholly, to the development of heat by hysteresis loss in the magnetic material.

This type of furnace should have a wide commercial application, though, to date, furnaces mostly have been constructed for merely demonstrating the principle; one, however, is in commercial operation at the plant of the Cleveland Twist Drill Co., for straightening twist drills.

Graphitization Furnaces

The best of all heat insulators at temperatures above 2,000 deg. C. is lampblack or carbon black. It is also an electric insulator when not strongly compressed. Hence, when a pile of carbon blocks are imbedded in this material and inductively heated with high-frequency current, they are heated rapidly and uniformly, and can be quickly brought to the graphitization temperature. The efficiency compares very favorably with other methods.

Extensive tests have been made of this application of high-frequency inductive heating. These tests were made at the request of several of the leading manufacturers of carbon brushes and other carbon articles which require graphitization. The writer believes this commercial application of high-frequency inductive heating is deserving of special and immediate consideration.

Miscellaneous Types of Furnaces

There is no method of heating more versatile than high-frequency inductive heating, and there have been many demands on the manufacturers to supply furnaces of very special type, and for a wide variety of uses.

60-Kw. Tilting and Pouring Furnace

A three-phase high-frequency converter supplied with thirty-six condenser units will absorb 60 kw. from the supply line, and will deliver from 60 to 70 per cent of this power to the terminals of a properly constructed furnace. Thus, with 40 kw. actually supplied to the furnace, or as much as 35 kw. in the form of heat to the crucible itself, it is possible and desirable to heat crucibles which hold as much as 600 lb. (273 kg.) of silver, or equivalent weights of copper, brass, bronze or other non-ferrous metals which melt under say 1,200 deg. C.

To handle and pour this quantity of metal it is advantageous to design the furnace for tilting and pouring through the medium of a heavily constructed mechanical mechanism.

One such furnace has been constructed, and is now in daily operation at the plant of Handy & Harman, Bridgeport, Conn. The furnace is designed and used for melting fine silver or sterling silver. Fig. 5 shows it when fitted for pouring.

The following features were embodied in its design and construction:

(*a*) The crucible and inductor coil are housed in a box made of sheet steel $\frac{1}{16}$ in. (8 mm.) thick. The box is 45$\frac{1}{2}$ in. (114 cm.) high, 31$\frac{1}{4}$ in. (78 cm.) wide, and 27$\frac{3}{8}$ in. (69 cm.) deep. The top of the box is fitted with a heavy molded refractory piece. This has a central hole 10 in. (25 cm.) in diameter—the inside diameter of the crucible—and a carefully shaped pouring spout.

(*b*) The crucible and its steel housing may be rotated for pouring around an axis which passes exactly through the end of the pouring spout. The crucible may be raised in the process of pouring 15 deg. above the horizontal.

(*c*) The movable portion of the furnace is counterweighted, whereby very little exertion is required to tilt and pour the charge.

(*d*) The space in front of the spout is free from mechanism, which permits molds to be brought by a carrier directly beneath the end of the spout.

(*e*) The furnace is free for approach by a man or a truck from behind, which arrangement gives facility to the charging.

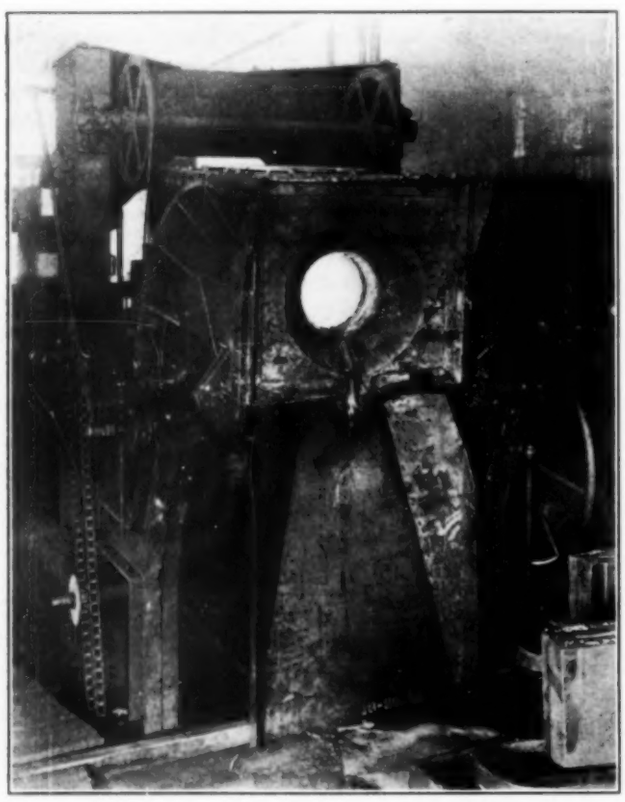


FIG. 5. FURNACE FOR HANDY & HARMAN IN POURING POSITION

(*f*) The furnace when in its vertical position makes electrical contact with three leads from the high-frequency converter, and when tilted for pouring breaks these contacts with no arcing. The furnace has, therefore, no moving electrical conductors.

(*g*) The inductor coils, three in number and star-connected, have water circulating through them. The water is led in and out of these coils at the two ends of the axis of rotation of the furnace, by which device all movable water connections are avoided.

(*h*) The inductor coils and the housing of the crucible and inductor coils are at all times at or near room temperature, which makes the furnace very comfortable to work around.

(*i*) The crucible is of carbon or Acheson graphite. It may be molded or turned out of a section of 12-in. (30-cm.) Acheson graphite electrode.

(*j*) The electrical insulation between inductor coil and crucible is a cylinder of micanite of a $\frac{3}{8}$-in. (1-cm.) wall (and thus is avoided the use of a rather fragile quartz cylinder), which material has been found suitable for many of the small furnaces that have been made.

TABLE I. REPORT OF ONE DAY'S OPERATION OF SILVER MELTING FURNACE

Time	Kw.-Hr. Meter	Current	Kw.	Weight Sterling Silver, Oz.	Notes
7:45	2,727.3	8.5	..	.....	
9:00	2,759.0	8.5	53	.....	Crucible at 961° C. Put silver in.
9:40	2,796.5	8.5	56	.....	Put copper in.
9:50	2,805.0	8.5	56	6,550.99	All melted.
10:00	2,812.5	...	..	.....	Start to pour 1135° C.
10:15	2,812.5	8.5	35	.....	Put silver in.
11:00	2,854.0	8.5	50	7,462.20	All melted.
11:15	2,875.5	8.5	50	.....	Started to pour.
11:30	2,875.5	8.5	35	.....	Put silver in.
12:15	2,915.0	8.5	50	7,500.00	All melted.
12:25	2,926.0	...	..	.....	Started to pour.
12:40	2,926.0	8.5	35	.....	Put silver in.
1:35	2,968.5	8.5	50	7,500.00	All melted.
1:50	2,979.0	...	..	.....	Started to pour.
2:15	2,979.0	8.5	35	.....	Put silver in.
3:50	3,034.0	8.5	45	7,545.30	All melted.
4:00	3,044.0	...	..	.....	Start to pour.
Totals....	316.7			36,558.49	

Melt	Rate of Melting: Melting Time Only Lb./Kw.-Hr.	Rate of Melting: Melting and Superheating Time Only Lb./Kw.-Hr.	Material
1	9.8	8.4	Fine silver and copper.
2	12.3	8.15	Sterling scrap.
3	12.7	10.2	Sterling scrap.
4	12.1	9.7	Sterling scrap.
5	9.4	8.0	Fine silver and copper.
Average.....	11.3	8.89	

Rate of melting: Average for all the time, 7.95 lb. per kw.-hr.

The performance of this furnace mechanically, electrically and metallurgically appears to be quite satisfactory. It is capable of continuous operation for eight hours or more and is actually being operated at the Handy & Harman plant in Bridgeport throughout a working day.

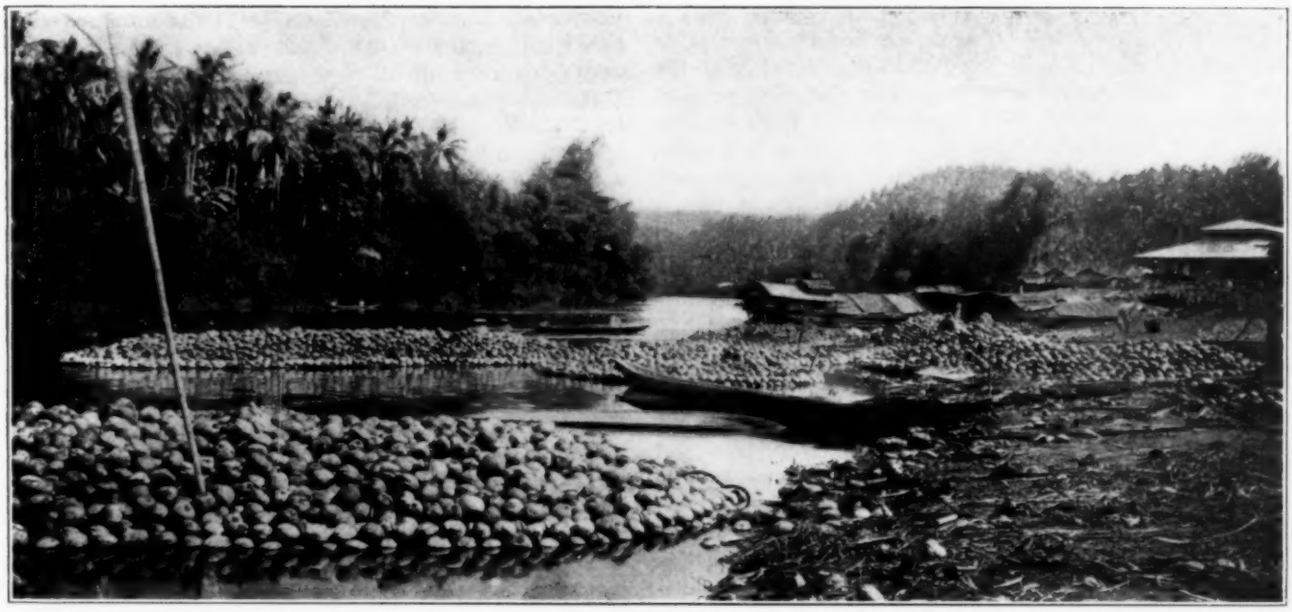
Table I shows the performance of one day's operation, and may be taken as typical of what the furnace is capable of doing.

General Performance

It may be said in conclusion that the highly useful accomplishments of high-frequency inductive heating are simply unlimited—provided high-frequency power is available in commercial quantities, and at a cost which is not prohibitive. Certain it is that high-frequency converters, of a static character, are now available at reasonable price in single units up to 60 kw., and that these units may be multiplied for operating a single large furnace without any undue complication.

Two years' experience in building and operating many high-frequency equipments—over 500 kw. were in service at the end of last February—have proved beyond a doubt that the principles of high-frequency induction presented before this society in April, 1919, are perfectly sound, and both laboratory and commercial installations have been made which show that this new method of electric heating has come to take its place with other electrical methods of heating for the permanent service of science and the industries.

Trenton, N. J.



COCONUT RAFTS

Oils, Fats and Waxes in Latin America

A Survey of the Resources—Linseed, Coconut, Palm Nut, Castor Bean, Sesame, Peanut, Brazil Nut, Mustard, Manihot, Argemone, Nigerseed—Essential Oils: Linaloe, Cayenne, Petitgrain, Orange, Lime, Bay and Pimento—Vanilla and Tonka Beans—Carnauba and Candelilla Waxes

BY OTTO WILSON

EXCEPT for a few stock products the area included under the term Latin America is almost an untapped reservoir of commercial commodities. In spite of the fact that South and Central America contained large and busy cities of 50,000 and more inhabitants before there was a permanent settlement in what is now the United States, most sections are still but thinly settled and their wealth continues to be largely latent. What is true of commercial commodities in general applies also to vegetable and animal oils. Outside of half a dozen products the resources of Latin America in this field have hardly been touched and great areas still await the explorer and calaloguer. The stretches of tropical forest and interior plains constitute a vast storehouse of these materials which can be unlocked only with the keys of labor, capital and transportation.

ARGENTINE LINSEED

So far as volume of exports is concerned the most important oil material that now comes out of Latin America is linseed. This is an Argentine product, one of the four or five chief crops of the wide River Plate plains. The area sown to flax each year in Argentina is greater than that in any other country of the world, being on the average about 3,000,000 acres, and at times the year's output from these plantings goes to over a million tons, or about 42,000,000 bushels, of seed. Before the war most of this production went to Europe, but in recent years the United States has been the chief buyer. So firmly established did this trade with Argentina become during the war that it has been steadily increasing ever since the armistice, and in 1920 importations reached the high value of $69,000,000. As the total imports of linseed into this country were about $74,000,000, it will be seen that Argentina has become the great source of raw materials to our producers of linseed oil. During the last year of the war this source of supply was so valuable that the United States Government for a while requested weekly reports as to the state of the flax crop.

In Argentina itself there has been a small development of the oil-crushing industry, principally in Buenos Aires, where five plants have a reported capacity of about 8,000 tons of oil a year. These are all under the management of Italians. Another large plant near Rosario is backed by Dutch capital. War conditions brought about some overseas exportation of linseed oil produced by these mills, but for the most part their output goes to satisfy local demands and the requirements of consumers in neighboring countries. The mills do not run to capacity and there does not appear to be much prospect of the expansion of the industry. There has also been some crushing of linseed in Sao Paulo, Brazil, the seed being brought from Argentina and also from southern Brazil, where it is grown to a limited extent.

COCONUT RESOURCES

Contrasting with the linseed industry, which has probably come near its peak of development, at least for

many years, is the coconut industry of the tropical countries, the expansion of which is largely a matter of the future. Although coconut trees are found in all the lands washed by the Caribbean, along the Pacific coasts of Mexico, Central America, Colombia and Ecuador, and in Brazil, the output of American lands is only a small percentage of the world's total. It is roughly estimated that throughout the world from seven to eight billion coconuts ripen every year, and of this number probably not more than 200 million are produced by the Western Hemisphere. Many millions of these grow in uncultivated groves and are lost entirely, or are used locally by natives of the forest. Most of those that enter into commerce come from the plantations, which are found chiefly in Jamaica, Trinidad and Tobago, the Bay Islands, Old Providence and St. Andrew's Islands off the coast of Central America, and in Honduras and Panama. Along the Pacific coast line from middle Mexico to Guayaquil, Ecuador, and along the northern coast of South America the tall trees are found in profusion, now scattered and now concentrated in thick groves, but in few places are the trees regularly cultivated or the nuts systematically gathered. According to an estimate transmitted in a report from an American consul Brazil has about 1,250,000 trees and produces annually 50,000,000 nuts, but they enter but little into any except local trade.

INDIAN WOMEN OF BRAZIL WITH BASKETS OF PALM NUTS

Throughout tropical America there is immense room for the expansion of coconut planting—the possibilities, in fact, are limited only by the demand for coconut products. There are two contingencies which will bring about this expansion. One is a steady increase during the next twenty-five or fifty years in the call from the world's markets for coconuts and coconut oil which will be loud and continuous enough to induce capital to tie itself up in this long-range investment. The other is a diversion of the United States import trade from the distant Orient to her southern neighbors.

During the war period, with its skyrocketing of prices for animal fats, the demand in the United States for coconut oil showed an immense and unprecedented expansion. In a short time imports of copra and coconut oil increased 700 or 800 per cent, reaching their highest point in 1918, when our copra purchases amounted to almost a quarter of a million tons and our purchases of coconut oil to more than 250,000,000 lb. This imported oil and that obtained from the imported copra went largely into the manufacture of oleomargarine, constituting 21.7 per cent of the total vegetable oils used in that industry in 1917, as compared with only four-tenths of one per cent in 1916 and before the European war. Since 1918, however, imports of coconut products have shown a marked falling off. Practically all of these heavy imports have been brought half-way round the world, from the Philippines and other Far Eastern lands, and scarcely any from the groves at our own doors.

The coconuts that come from Latin America are all imported "in the shell," and our total supply of whole nuts comes from these importations. Except for the sparsely settled condition of most Latin American countries and the consequent scarcity of labor and primitive conditions of transportation, there is no reason why that section should not some time send us our requirements in copra and oil as well as in nuts for confectionery and direct consumption. There is, however, no present indication that this change in traffic will take place. There is a considerable production of oil in Trinidad, Panama has an American factory of fairly large capacity, and some oil is produced in other localities, but this is all for local consumption. There is no effort to compete with the Philippines and other Far Eastern mills in shipping to the United States or European markets, and it will be a long time before the American coconut sets up as a rival to its Oriental cousin in the oil-producing business.

Palm Nut and Castor Beans

Two other tropical oil materials which can be produced in great quantities when the need becomes sufficiently pressing felt the stimulus of war demands, and one of them has been gathered in Brazil in continually increasing quantities since the armistice. These are palm nuts and castor beans. The former is the product of several different species of palm belonging to the same family as the coconut and the West African palm, and the trees are found all the way from Mexico to southern Brazil.

There are various names for the different species, such as cohune, corozo and coquito, and there is a confusion of names in the different localities. What is usually known as the cohune nut (*Attalea cohune*) is found most plentifully in British Honduras, Honduras and Guatemala, but trees also grow to an undetermined extent in Mexico and the Caribbean side of Panama. A cousin of the cohune tree (*Attalea gomphococca*) with narrower nuts and thinner shell, grows plentifully in western Mexico, the Pacific side of Central American states and on down through tropical South America, and other species are found scattered through the jungles of all this tropical region. Brazil has a number of them, and one of them which bears a fruit very similar to the well-known West African palm nut occurs in Panama and the adjoining Atrato district in Colombia.

Like the West African palm nut the nuts of these various species yield two oils, a kernel oil similar to coconut oil, and an outside oil contained in the pulp surrounding the seed, which must be expressed in the country where the palms grow, as it evaporates when the nuts are shipped overseas. Various attempts have been made to utilize the tens of thousands of tons of these nuts which ripen annually, but so far with little success in Latin America. The coconut-oil factory in Panama mentioned above has worked up limited quantities and a few thousands of dollars' worth of the oil has been exported by a factory in Colombia, but production

is largely a side line to that of coconut oil. The war demand for these nuts was not for the oils, but for the shell, which was found to be one of the best of all materials for making absorptive charcoal for gas masks. Thousands of tons were gathered for this purpose, but only the extraordinary conditions made it profitable to get them out, and collection stopped short with the armistice.

When it became known that castor oil was in demand for airplane engines and the allied governments sent out calls for immense quantities, there was a wave of interest in nearly all countries of Latin America, as the castor-bean plant was found growing everywhere and in many places was looked on as a pest. Thousands of acres were quickly planted in Cuba, the Dominican Republic and other West Indian islands, in several Central American countries, and in Colombia, Venezuela, Peru and Brazil.

When the war demand ceased the cultivation of the plant in general dropped off and the industry of gathering and crushing or exporting the seeds returned to about what it had been before the war, serving mostly local needs. But in Brazil the momentum acquired during 1917 and 1918 has continued, as is strikingly indicated by the export figures. In 1915 the exports of castor seed were only 234 tons and of castor oil about 8 tons. By 1918 they had mounted to 4,066 tons of seed and 3,830 tons of oil, and by 1919 to 23,777 tons of seed and 1,389 tons of oil. In the first six months of 1920, according to the latest available statistics, exports were 15,570 tons of seed and 450 tons of oil. It is evident that the Brazilian castor seed is making a strong bid for the trade formerly held by India. Most of the seed has been coming to the United States, with smaller proportions going to Great Britain, Portugal, Belgium and Germany, while Italy, Spain and France have taken most of the oil. Pressing is carried on largely in the Sao Paulo district in connection with the production of other vegetable oils, and activity fluctuates with the demand for the product. Much of Brazil's seed comes from the wild trees, although planting has reached many thousands of acres.

PALM TREES IN BRAZIL
The thick vegetation adds materially to the difficulty and expense of collection.

SEPARATING BROWN COTTON FROM WHITE AT A COTTON GINNERY IN PERU

Cottonseed Oil

Cottonseed crushing has also reached its greatest development in Brazil, which country indeed seems to be the great future field for the production of vegetable oils. Cotton seed is obtained when the home-grown cotton is cleaned and prepared for spinning into yarn and thread for the several hundred textile mills of the country, and in many cases the seed is obtained and sold or crushed by these mills themselves. The growing of cotton and the manufacture of cloth, as well as the crushing of seed, are directly encouraged by the federal and state governments by loans and otherwise, and the future expansion of the industry is assured. Other countries in which cotton is grown and the seed crushed are Peru, Colombia, Venezuela, Argentina, Mexico and various West Indian islands.

Sesame Oil

In addition to these oil-producing plants those whose development in Latin America is advanced to only a fraction of their possibilities make a long list. Without attempting to catalog them all, the following may be mentioned: The sesame plant has been cultivated chiefly in Mexico, where it is known as "ajonjoli." According to an official report of a United States trade commissioner, "sesame seed is one of the articles of Mexican agricultural production which is capable of tremendous development and wherein lies almost unlimited commercial possibilities. There are two easily distinguishable varieties of sesame, the white and the brown. Both of these are produced in Mexico. . . . Authoritative and expert opinion testifies that the only requisite needed to produce an almost unlimited supply is increased utilization of the acreage now lying idle.

"In view of the world demand for edible oils, there is reason to expect a development along this line in the near future. The oil content of sesame, according to Mexican Government estimate, is 50 per cent. Others place the content at 56 per cent. Aside from this the pulp is highly nutritious. In view of these facts, sesame compares favorably with cotton seed in food value. It is almost equal to the olive in oil content, and in taste, odor and adaptibility for commercial uses it is quite as desirable as the latter. . . . The white variety is said

to be richer in oil content than the two subvarieties of black or brown sesame.

"There are fifteen factories of different sizes and of varying importance in the city of Mexico engaged in the extraction of sesame oil and in its preparation for market. The greater number of these, however, are one-press affairs with very slight capacity. . . . The first-grade oil is used for seasoning and for the same miscellaneous culinary purposes that olive oil and lard are used for. The better grades of oil are used also in the manufacture of oleomargarine and to adulterate other edible oils. The inferior oils are used for soap-making, as a combustible, and as a basis for perfumes. [This use in perfumery manufacture has been questioned and is subject to verification.—O. W.] The leaves of the sesame have medicinal value and contain gelatinous substances. The pulp which remains after the oil is extracted is valuable as stock food."

Peanut Oil

Peanuts, also known as groundnuts, earthnuts, monkey nuts, etc., are found in all parts of Latin America and in many places are crushed for oil, notably Uruguay, Argentina and Brazil. Exports of peanuts from Brazil have reached as high as 1,100 tons in one

PEANUT FIELD, CAMPO LARGUIA, ARGENTINA

year. Olive trees take up several thousand acres in Chile, and the fruit is also raised in the neighboring country of Argentina. Peru has olives of good quality and exports a few tons each year, but consumes most of the production herself. Olives are grown commercially in several states of Mexico, the fruit being sent to the refineries of the capital.

Brazil Nuts

Brazil can fairly claim first place as the home of new oil-bearing seeds and nuts that promise to develop into important commercial commodities. Among these are the babassu and ucuhuba nuts and those commonly known as Brazil nuts, all of which have been exploited sufficiently to form considerable items of export. The babassu nut is a palm nut related to the coconut, whose meat is similar to coconut meat and whose oil is said to be excellent for oleomargarine. The nut yields about 66 per cent oil. The trees are found mainly in the interior of the north, along the Parnahyba River, and gathering has progressed to the point where some thousands of tons are exported annually.

Ucuhuba nuts (*Myristica bicuhyba*) yield a fat which becomes hard and brittle and may be refined to an almost odorless condition, although as marketed the nut is yellowish brown and has an odor similar to that of coconut oil. It consists mostly of myristin with about 10 per cent of olein and a small amount of an ethereal oil. It has a melting point of 35 to 42 deg., a specific gravity of 0.871 to 0.912, and an iodine value of 9.5 to 18.5 per cent[1]. These nuts also come from northern Brazil and in 1918 and 1919 exports amounted to over 1,000 tons, besides which large quantities were used in Brazil candle manufacture.

The Brazil nut so familiar in confectionery stores yields a fine semi-drying oil said to be valuable for cooking and also for use by watchmakers and artists. The nuts contain up to 73 per cent of oil, which is of a pale yellow color and has a taste similar to that of the nut itself, but is without odor. In South America the oil is used for edible purposes, and soap is made from nuts that become moldy in shipping. The oil has a saponification value of 193.4 to 202, according to tests made, an iodine value of 98.3 to 106.2, and a specific gravity of 0.918.

Mustard Oil

Both the black and the white mustard are found in Brazil, and the seeds yield 10 to 15 per cent of their weight in a semi-drying oil, similar in chemical properties to rape oil. The oil from the black seed is not suitable for burning and is chiefly used in making soap, while that of the white seed is used both as a burning and a lubricating oil. No tests of the Brazilian seeds are reported, but Italian black seed showed a specific gravity of 0.917, an iodine value of 112.7 and 116.1, and a saponification value of about 175. The white seed is similar to the black except that it has a lower iodine value.

Cashew or caju nuts are a regular item of export. It is said that they are growing in favor in the manufacture of chocolates. The oil is a non-drying oil with an iodine value of 84 and a saponification value of 195. Brazil can supply all that the trade requires.

Manihot Oil

The seeds of the famous rubber trees of Brazil yield two different kinds of oil, one from the species of tree growing in the State of Ceara, called manihot oil, and the other from the Para rubber tree and known by that name. Both are drying oils. The former is of a yellowish-green color, with an odor resembling that of olive oil and a slightly bitter taste, and in Brazil it is expressed to be used as a substitute for linseed oil. The latter is of a light yellow color with an odor like that of linseed oil. The cake is said to be unsuitable for cattle feed because of the presence of a small amount of prussic acid. For both oils the specific gravity has been found to be about 0.923 and the saponification value around 189; the iodine value of the manihot oil, according to one test, was 137 and that of the Para seed oil 117.6 to 133.3.

Argemone Oil

The Mexican or prickly poppy, native to Mexico and the Caribbean islands, yields an oil called "argemone" oil, which is used for burning and lubricating purposes and also has a recognized therapeutic value. It is of a light yellow color with a distinctive acrid odor and is classed as a drying oil. The seeds yield commercially

[1]Data relating to properties of fixed oils are taken largely from Lewkowitsch, J. I., "Chemical Technology and Analysis of Oils, Fats and Waxes," Vol. II, and data relating to properties of essentials from Parry, E. J., "The Chemistry of Essential Oils and Artificial Perfumes."

about 25 per cent of their weight in oil. The oil has a specific gravity of 0.924, a saponification value of 187 to 190, and an iodine value of 119.9 to 122.5, according to the results of laboratory analyses. Brazil also produces poppy-seed which is said to give 28 liters of oil to 100 liters of seed, the oil being expressed for use by painters, particularly in painting wood.

Nigerseed Oil

Nigerseed oil, a yellow, drying oil with a nutty taste, is found in the West Indies, but has not been developed into a product of commercial importance. In India this oil is used as a substitute for ghee, or native butter. Lower grades are also of value for soapmaking, the saponification value running about 190, and as a substitute for linseed oil. Another oil used for much the same purposes is sunflower oil, considered as a drying oil, although it dries more slowly than most others of that class. The soap made from it is said to be especially suitable for textiles. It also enters into varnish manufacture, and is used locally for cooking and burning purposes. It has a saponification value of about 190, a specific gravity of about 0.92, and an iodine value of 119 to 135. Sunflowers are indigenous to Mexico and planting there can be indefinitely extended if the demand grows. In Argentina they form a minor crop of some importance, exports of sunflower seed in 1919 amounting to over 4,000,000 lb. valued at about $120,000.

Miscellaneous Oil-Bearing Seeds

The soya bean of the Orient has been successfully grown in the Guianas of South America, but it is not produced in quantities. Corn oil is pressed out from some of the abundant crop of maize in Argentina and in 1917 shipments to the United States amounted to over 330,000 lb., although this was due to extraordinary conditions and normally this country does not import from Argentina. The seeds of the kapok plant, which is grown in many parts of tropical America for its fiber, yield an oil very similar to cottonseed oil, which is used locally for edible purposes and in Europe for soapmaking. It has a saponification value of 181 to 205 and an average iodine value of about 120. A semi-drying oil called "pinot" oil, the fat of which is known as Para butter, is taken from the kernels of the pinot or ouassey palm in Brazil and French Guiana, where it is used for edible purposes.

In Central America some attention has been given to the production of piñon or curcas oil, which has purgative qualities much more pronounced than those of castor oil. It is used locally for soapmaking and as an illuminant and also occasionally as a lubricating oil, although it is not very suitable for that purpose, as it dries in about twenty-four hours. Jamaica produces a non-drying oil called ben oil which has been known for a century as especially valuable for lubricating delicate machinery. It is odorless, has a sweet taste, and in the East has been used as a cosmetic and as an agent in the extracting of perfumes from flowers. It has a specific gravity of about 0.92, a saponification value of 184 to 187, and an iodine value of about 111.

French Guiana grows a tree whose seeds are known as "Java olives," which yield a yellowish-colored oil which when heated solidifies to an india-rubber consistency. In Brazil and the Guianas occur the "paradise-nut" trees, the nuts of which are about one-half oil, and resemble Brazil nuts, although with larger kernels. They are highly esteemed as a food article and so are

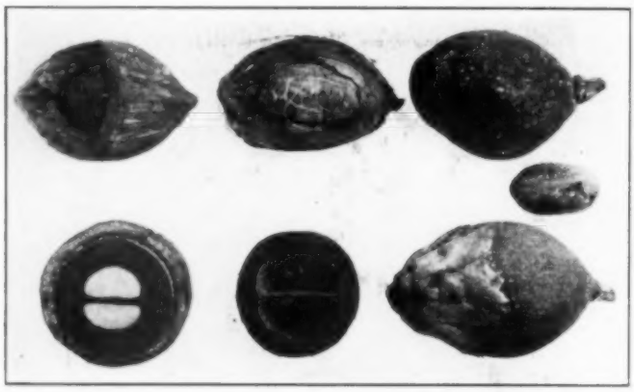
COHUNE-NUT TREE IN CENTRAL AMERICA
Showing size of bunches of nuts as compared with size of a man.

seldom exported, although the trees are found all over Brazil. Corapa oil is obtained in the Guianas from a plant of that name and is used by the natives to protect themselves against insects and also for lighting. French Guiana has a palm oil called aoura or tucum oil, which is used for cooking, and the Guianas also produce a butternut from which an edible fat called "suwarri" is obtained.

Argentina produces and exports considerable quantities of rapeseed from which the well known rape oil or colza oil is expressed. In 1919 shipments abroad amounted to 1,200,000 lb. valued at $41,000. This oil is widely used as a lubricant, and for two other special but very different purposes. Bakers use the better grade of colza oil for greasing the ends of their loaves, and the commoner grades are used for quenching steel plates.

Essential Oils

In the field of essential oils the contributions which Latin America is making or stands ready to make to the world's commerce are also numerous and valuable. For the most part they are the products of the tropical regions of northern South America, Mexico, Central America and the West Indies, wide areas of which yet remain to be explored. It is reasonable to expect that this *terra incognita* contains many oils, nuts and woods not yet catalogued. The value of the essential oils now produced is small compared with that of other commercial products, but that is due not to small resources or



THE COHUNE NUT OF CENTRAL AMERICA
The thick, hard shell of this nut was what made it so valuable for gas-mask manufacture and led to the gathering of some thousands of tons during the war.

possibilities, but to the fact that the demand is not insistent enough to overcome costs of exploitation in undeveloped territories.

Linaloe Oil

Mexico and French Guiana produce one of the best known perfumery oils distilled from wood—the lignaloe or linaloe oil, but the product that goes by that name in Mexico is quite different from the Cayenne or French Guiana product. The Mexican oil is obtained from a tree known locally as "bois de citron du Mexique," which is found in the southern part of the country. The best oil comes from trees 40 to 60 years old, although oil is also obtained from younger trees and from the fruit. Distilling is carried on both in Mexico and in Europe, to which quantities of the wood are regularly shipped. The oil is colorless or pale yellow, with a sweet odor, and a specific gravity of 0.875 to 0.898. It is soluble in 3 volumes of 70 per cent alcohol or in 4 or 5 volumes of 60 per cent alcohol. The most important characteristic of the oil is the free linalol, which has an odor like lily of the valley and which is present to an undetermined extent. Parry also mentions two samples of linaloe oil from Mexico which had an odor of blended lavender and petitgrain, a specific gravity of 0.897 and 0.893, and an ester content of 52.4 per cent and 48.7 per cent, of which he says:

"Particular attention is directed to this oil, because it may be that it would be well to develop the distillation of this particular wood for its content of linalyl acetate and for the purposes for which oils containing that ester are used, rather than for linalol and the purposes for which oils containing that alcohol are employed."

Cayenne, Linaloe and Sandalwood Oils

The Cayenne oil is derived from a species of wood distinct from that of Mexico and usually known as "bois de rose femelle," although the botanical origin is not quite clear. The oil is very similar to Mexican linaloe oil and is not to be confused with the oil known commercially as rosewood oil, which is quite a different product. The wood from which the oil is distilled, however, is gathered in and exported from French Guiana under the name of rosewood. Both the wood and the oil are exported. The wood yields about 1 per cent of oil, which in the pure state has a specific gravity of 0.87 to 0.88 and an ester value of 3 to 7. French Guiana also produces limited quantities of a wood which has taken the name of that most ancient and historic of aromatic woods, sandalwood, although it is quite different from the Indian product. Its botanical and chemical characteristics do not appear to have been yet determined accurately. There is also a West Indian sandalwood, very similar to the rosewood of French Guiana, known as the "bois de citron" of Domingo, which has been shipped to Europe for over a century. The oil is a thick yellow oil with an odor similar to that of cedarwood oil. It has a specific gravity of 0.948 to 0.972 and is soluble in an equal volume of 90 per cent alcohol. It has been used as an adulterant and substitute for the genuine sandalwood oil.

Petitgrain Oil

Citrus plants yield a number of different kinds of essential oils all of which figure as more or less important Latin American products. The oil of petitgrain, distilled from the leaves, buds and young fruit of the orange tree, forms the chief item of direct export to the United States from Paraguay, where the industry of extracting it has been considerably developed because of the existence there of great numbers of bitter orange trees. The oil or essence is obtained by passing steam through a quantity of leaves packed in a specially designed receptacle, from 500 to 600 lb. of leaves being required to produce a quart of oil. This South American product is inferior to most other petitgrain oils received on the world markets, probably because the extraction is carried on under rather primitive conditions. Its specific gravity, about 0.887, and its ester content, about 36.5 per cent, are both higher than other petitgrain oils. Oil of petitgrain is used as a basis of perfumes and perfumed toilet soaps. Another valuable product of the Paraguay orange groves, exported to a limited extent, is oil of neroli, obtained from orange blossoms.

Orange Oil

The production of orange oil, which comes from tiny vesicles in the skin of the fruit, has been especially prominent in Jamaica, and exports have at times amounted to more than $100,000 a year. Both bitter oranges and sweet oranges are used as a source of this oil, but that from the sweet oranges is considered best. It takes almost 500 oranges to supply a pound of filtered oil. Most of the Jamaican product comes to the United States and is used in the making of perfumes, flavors for soft drinks, and essences, and particularly for flavoring a certain kind of fancy biscuit. It is also used in drug manufacture and to a small extent in the manufacture of soaps. The Jamaican orange oil is said to be equal or superior to the Sicilian product.

Oil of Limes

Oil of limes in the West Indies is of two kinds, one which is distilled, being obtained as a byproduct in the concentration of limejuice, and the other hand-pressed, of a higher specific gravity (0.878 to 0.902, as compared with 0.860 to 0.872 for the distilled) and a higher commercial value. The distilled oil is the usual oil of commerce. It forms a regular export item from many West Indian islands, among which the more important producers are the islands of Montserrat, Jamaica and Dominica. The leaves of the West Indian lime tree also yield an essential oil on distillation. Lemon oil is also a possibility of these regions, particularly of Jamaica, but its production has not yet become an industry. Mexico is a particularly promising field for the establishment of a lime-juice and lime-oil industry. Lime trees are at present cultivated hardly at all, but they

grow wild over a wide area and could be utilized in producing large quantities of oil of limes, lime juice, and citrate of lime.

Bay and Pimento Oils

Besides orange and lime oils the chief essential oils found in the West Indies are bay oil and pimento oil. The bay tree grows abundantly in Jamaica, St. Thomas, Guadeloupe, Antigua, Barbados and Dominica. Both the leaves and the oil are exported to the United States, and are constant items in the lists of exports of those islands. Bay oil, which is used in perfumery and as a basis of bay rum, when distilled from the leaves separates into two portions, one lighter and the other denser than water, the two being combined to give a normal distillate. The oil contains 55 to 68 per cent of phenols, but the amount is found to vary with the different seasons of the year.

Oil of pimento is distilled from the fruit of *Pimenta officinales*, indigenous to the West Indies and found especially in Cuba, Haiti, Trinidad, Santo Domingo, Antigua and the Leeward and Windward Islands, and abundantly in Jamaica. It also occurs in Mexico, Costa Rica and Venezuela. Pimento berries, which are gathered green, have an aromatic odor in which can be detected the odor of cinnamon, nutmeg, pepper and especially cloves—hence the popular name of "allspice" applied to them. They yield 3 to 4½ per cent of a dark-reddish oil of the same aromatic odor as the fruit. It contains phenol-eugenol, which gives it the clove-like odor, the phenols being present to the extent of about 65 to 80 per cent. The oil has a specific gravity of 1.024 to 1.056.

Other possibilities of Jamaica, not yet developed, include vetivert and camphor. Camphor trees grow in considerable numbers in Jamaica, and a special test of the camphor derived from their leaves and wood which was made several years ago showed that it was of fully as good quality as that from the Far East.

In the River Plate countries, Argentina and Paraguay, grows a tree indigenous to that region which yields an oil of some importance commercially. This is the champaca or guaiacum wood oil, not, however, to be confused with the true champaca oil of Europe. The wood yields 4 to 8 per cent of essential oil which is practically solid at ordinary temperatures. It has an exceedingly delicate odor described as resembling that of tea and violets, and it is used in perfumery to produce a tea-rose odor and to blend with stronger perfumes for ordinary scents, and sometimes as an adulterant of otto of roses. It is often mixed with geranium oil and used under the name "essence de la gaïac à la geranium." Its specific gravity is given as $.965 to 0.975 at 30 deg., and it is soluble in 3 to 5 volumes of 70 per cent alcohol.

AMERICAN UPLAND COTTON IN PIURA, PERU, LOCALLY KNOWN AS "EGIPTO"

Miscellaneous Essential Oils

Other essential oils and materials from which they can be distilled cover a wide range. Flowers and blossoms of trees which yield fragrant perfumes abound in rich profusion throughout the tropical forests of the Amazon and Orinoco valleys, French Guiana alone being credited with half a hundred or more. In Brazil, to mention two or three of the many plants aside from those described above, the leaves of a plant called the "false jaborandi" yield a light-greenish oil of spicy mint-like odor and pungent burning taste; the leaves of the "catingueira" furnish an oil with a greenish fluorescence and an odor resembling bergamot; the wild lemon tree leaves contain an oil having an odor of bergamot and lemon, and those of the wild coffee tree an oil with a lemon-like odor; from the bark of *Cassia caryophyllata* is obtained an oil containing eugenol and having a clove-like odor. In Bolivia is a grass which belongs to the same family as lemongrass and citronella, yields an oil similar to vetivert, and grows very abundantly. In British Guiana and Brazil the priprioca tree's branches contain an essential oil somewhat similar to linaloe oil. Throughout Mexico, especially around Mexico City and other cities and towns, grow a great profusion of cultivated flowers such as poppies, pansies, carnations, chrysanthemums, violets, gladioli, and irises. Nutmeg or mace oil is a product of several localities. Mexico and Central America yield turpentine, which may some day be drawn upon to help preserve the diminishing supplies in the United States.

A well-known oil which comes from Brazil, Venezuela and Colombia is copaiba oil, imported into the United States usually in the form of copaiba balsam. Northern Brazil has seven species of *Copaifera officinalis*, from which the balsam is taken. In Bahia the oil is extracted by means of suction pumps. Closely related to copaiba balsam is balsam of Peru, which comes largely from Salvador. Tolu balsam, a similar product used in perfumery, comes mainly from Colombia.

Vanilla Beans

Two other products, which are not essential oils but are widely used as flavoring extracts, may be mentioned. These are vanilla beans and tonka beans. The original home of the vanilla bean is said to have been Mexico, and that country continues to be one of the chief producers, although the tiny colonists sent out to other tropical lands have established themselves so well that most of the world's supply now comes from Old World sources. In Mexico the vine grows both wild and cultivated. The State of Vera Cruz is the center of cultivation. The beans grow in pods, 6 to 9 in. long, and it is the carefulness observed in curing and drying these pods which determines the flavor of the commercial product.

The curing process consists of piling the pods in heaps for a few days, then exposing them to the sun, then wrapping them in a woolen blanket, and at night permitting them to sweat in air-tight boxes. They are then dried for about two months in the sun. Mexican vanilla is rated very high as compared with the product of other countries. In the West Indies several islands raise vanilla, and its cultivation in the French island of Guadeloupe has made it one of the colony's chief resources.

Tonka Beans

Venezuela and the neighboring islands of Trinidad and Tobago are the chief source of tonka or tonquin beans, although the trees are also found in the Guianas and Brazil. These beans grow in long pods, which are gathered and dried until the pulp shrivels, when the shells are cracked and the seeds or beans are extracted. After being put through a process of preparation and drying they are exported to be used for various purposes such as scenting tobacco and snuff, fumigation, and use in sachet powders. They furnish coumarin, an essential ingredient of perfumes and flavoring extracts.

Animal Fats

Of the animal fats the chief is of course the lard and tallow which form one of the important products of the meat-packing establishments of the River Plate countries and southern Brazil. These plants also turn out certain quantities of bone grease and bone oil, and the United States obtains from them large amounts of neatsfoot oil and stock. From the wool-growing countries Argentina and Uruguay come supplies of wool grease or lanolin. Brazil has developed the whaling industry to the point where whale-oil exports amount to $45,000 or $50,000 annually, besides which large quantities are consumed locally. The states of Pernambuco and Bahia are the chief centers of the industry, and the season usually lasts from April to August or September, when the Antarctic whales come north to find warmer waters. Turtle oil and alligator fat are possible products of Caribbean coast regions which have not yet received much attention.

Carnauba and Candelilla Wax

Among the waxes of Latin America the one which occupies first place commercially is a product of Brazil —carnauba wax. It has a variety of uses. Candles, polishing pastes, varnishes and phonograph records are made from it and it is also used for cable coverings, waterproofing, etc. In 1919 Brazil sent 13,700,000 lb. of this wax, valued at $5,000,000, to foreign countries, chief of which was the United States, which took 7,000,000 lb., and Great Britain, 3,200,000 lb. The wax is especially plentiful in the State of Ceara, in the northern part of Brazil. The leaves of the palm tree which furnish this wax are gathered during the months from September to March, from 2,000 to 4,000 leaves being required to supply 16 kilos of wax.

In Mexico an important wax called "candelilla" is obtained from a low-growing plant of that name which is found all over the northern part of the country. Many factories have been set up to extract this wax by boiling the plants in water to which sulphuric acid is added. The city of Monterey is one of the centers of manufacture. The wax is very hard and has a melting point of 150 to 175 deg. F., and can be bleached perfectly white. It is said to be more brittle than beeswax, and dissolves in turpentine, chloroform, hot ether and benzine. It makes excellent candles, varnish and shoe polish, and may also be used for making phonograph records, insulation for electric wires, and plasters and ointments.

Beeswax comes from all parts of Latin America. Brazil exports very considerable amounts and the United States also receives small shipments from Ecuador, Mexico, Cuba and various other countries and islands. Ecuador reports a kind of palm wax which might be used in place of beeswax and for which local producers have requested inquiries from possible United States buyers.

Refining Chinese Bismuth Concentrates

By Elton R. Darling

THE Chinese bismuth concentrates are yellow in color and vary in size from 4 to 100 mesh. They analyze about 58 per cent bismuth oxide, with 5 per cent of antimony and 0.14 per cent of arsenic, both expressed as the metals. The presence of antimony and arsenic renders the treatment of these concentrates for pure bismuth very costly.

The writer has been engaged upon researches whereby these two metals could be eliminated cheaply and the bismuth used for pharmaceutical purposes.

The following process gives satisfactory results:

The concentrates as received are reduced to about 80 mesh and dumped into vats, where they are extracted with warm hydrochloric acid solution prepared by the action of sulphuric acid upon a solution of sodium chloride. After extraction the whole is allowed to settle and the liquor drawn off into a second vat and this treated with metallic iron to precipitate the antimony and bismuth. The arsenic is not affected and remains in solution. The whole is then filtered and the resulting solution returned to the ore for a second extraction.

The gray precipitate containing the antimony and bismuth is washed well with water, spread out upon trays, and dried. The completely dried mass, in which the bismuth is in the form of hydrate, is then treated with a 15 per cent solution of hydrochloric acid; when the bismuth hydrate dissolves, the antimony, being insoluble, settles to the bottom. The solution of bismuth chloride is then drawn off and added to a large volume of water, which causes the precipitation of bismuth oxychloride. This is allowed to settle, the water drawn off and more fresh water added, the washing being repeated until the wash water is free from acid. The bismuth oxychloride is dried, mixed with charcoal as a reducing agent and with sodium carbonate, lime and fluorspar as a flux and reduced to the metal in iron crucibles.

Bromine in 1920

Bromine, which is derived from brines pumped from deep wells in Michigan, Ohio and West Virginia, was produced by eight firms in the United States in 1920. The output, according to the United States Geological Survey, was 1,160,584 lb., valued at $745,381, a decrease of 37 per cent in quantity and nearly 40 per cent in value from the output in 1919. The quantity produced, however, was greater than in any year before 1918.

The average price per pound received by the producers rose from 13c. in 1910 to $1.31 in 1916 and was 64c. in 1920, which is more than three times the average price in the year before the war.

The Use of Fluorides in Solutions for Nickel Deposition*

An Outline of the Experimental Work Leading to the Conclusion That Deposits of Nickel of Finer Structure and Higher Tensile Strength Are Obtained From Fluoride Solutions Than From the Corresponding Chloride Solutions

By WILLIAM BLUM†

IN CONNECTION with a process for the electrolytic reproduction of engraved printing plates, recently installed at the Bureau of Engraving and Printing under the supervision of the Bureau of Standards, it was necessary to secure for the printing surface nickel coatings which would be as hard as possible, but at the same time free from brittleness or a tendency to curl. In connection with this process the addition to nickel solutions of hydrofluoric acid or fluorides, recently recommended by E. G. Lovering, was investigated. The beneficial effect of such additions upon the physical properties of the deposited nickel was found to be so great that this type of solution was adopted and has been used successfully in the above-mentioned plant.

Historical

As the nickel solutions employed usually contain boric acid, we may assume that upon the addition of fluorides, fluoborates are formed. The use of fluoborate solutions for plating was first proposed by Leuchs,[1] who made experiments with several metals but not with nickel. In 1908 Kern and Fabian[2] employed a nickel fluoborate solution, from which they secured a thick deposit ($\frac{3}{16}$ in. = 8 mm.) having desirable physical properties. About this same time, O. P. Watts[3] and his associates made a few experiments with nickel solutions containing fluoborates and also secured promising results. In 1912 they found that good deposits could be secured from nickel fluoride solutions containing free hydrofluoric acid. In the same year A. Hollard[4] experimented with a nickel fluoborate solution for making electrotypes. So far as known to the author, however, no commercial applications of nickel solutions containing fluorine was made until recently, when E. G. Lovering,[5] of Detroit, operated plating solutions containing in addition to the usual constituents—viz., nickel sulphate and boric acid—small amounts of hydrofluoric acid. He obtained such remarkable results that he designated hydrofluoric acid as the "magic fluid." Subsequently F. J. Liscomb[6] published the results of a few experiments in which he employed solutions of nickel fluoborate and nickel-ammonium fluoborate, from both of which he obtained only fairly satisfactory deposits.

Publication and discussion of Lovering's results caused numerous electroplaters to try the use of hydrofluoric acid in nickel baths, with thus far somewhat contradictory results, owing in part, no doubt, to failure to define or control all of the conditions employed by them. Even though very marked effects are produced by the fluorides in the presence of boric acid, there is no reason to believe that such solutions form a panacea for all the ills of the plater. Just as the studies of cobalt plating several years ago led to important improvements in nickel plating, the investigation of fluoride nickel solutions may throw light on the behavior of the nickel solutions more commonly used, and may thereby lead to their improved operation.

General Principles

If hydrofluoric acid is added in small amounts to a nickel bath, the acidity thus produced will cause an increase in anode efficiency and a decrease in cathode efficiency, and at least a partial neutralization of the hydrofluoric acid, to form either nickel fluoride, or, in case boric acid is present, a fluoborate. Since good nickel deposits cannot be secured from solutions which are appreciably acid, the solution must be operated for some time after the addition of hydrofluoric acid, or the bath must be neutralized, before satisfactory results are obtained. It therefore appears more logical to neutralize the hydrofluoric acid before adding it to the bath.

In order to produce baths of relatively simple composition the fluorine was first added in our experiments in the form of nickel fluoride, prepared by the solution of nickel carbonate in hydrofluoric acid. When commercial nickel carbonate in excess is treated with 5*N* hydrofluoric acid a solution is obtained which contains only about 80 per cent of the amount of nickel equivalent to the hydrofluoric acid used. It is evident, therefore, that in such solutions there is a tendency to form acid fluorides. With freshly precipitated nickel carbonate, neutralization is more rapid and more nearly complete, but in no case is a neutral solution obtained. This observation is in general accord with the experiments of F. H. Edminster and H. C. Cooper,[7] who found that if hydrofluoric acid is neutralized with nickel carbonate the definite crystals obtained by several recrystallizations have the formula $NiF_2.5HF$, although there is a tendency to form crusts having approximately the composition NiF_2. For simplicity, we may assume that the solution contains nickel fluoride, NiF_2, and a small excess of hydrofluoric acid.

If now boric acid in excess is added to such a solution, a precipitate, which probably consists of nickel hydroxide, separates, and the resultant solution contains

*Paper presented at the spring meeting of the American Electrochemical Society, April 23, 1921. Published by permission of the Director of the Bureau of Standards.

†Electrochemist, Bureau of Standards, Washington, D. C.

[1]German Pat. 38,193, May 13, 1886.

[2]*School of Mines Quarterly* (1908), vol. 29, p. 367. *Trans.* Amer. Electrochem. Soc. (1909), vol. 15, p. 464.

[3]Unpublished address delivered before the Chicago branch of the American Electroplaters' Society, Jan. 29, 1921.

[4]*Bull.* Soc. d'Encour (1912), p. 24. *Brass World* (1912), vol. 8, p. 391.

[5]*Monthly Review*, American Electroplaters' Society, February, 1920.

[6]*Brass World* (1920), vol. 16, p. 311.

[7]*J. Am. Chem. Soc.* (1920), vol. 42, p. 1,419.

nickel in the ratio of approximately 1Ni to 4F. About the same ratio is obtained if the hydrofluoric acid and boric acid are first mixed and the resultant "fluoboric acid" is neutralized with nickel carbonate. It is difficult to assign a formula to the "fluoborate" which probably exists in such solution. If we assume the simplest formula for fluoboric acid—viz., HBF_4—we would expect the formation of nickel fluoborate having the formula $Ni(BF_4)_2$—i.e., with 1Ni to 8F. To produce such a compound by reaction between nickel fluoride and boric acid would require a reaction such as the following:

$$4NiF_2 + 2H_3BO_3 = Ni(BF_4)_2 + 3Ni(OH)_2$$

The reaction which actually occurs is apparently similar to this, but no doubt less simple, and the salt formed is a more complex fluoborate. Hollard[8] used hydrofluoric acid and boric acid in proportions to yield a solution approximately 0.8*N* in HBF_4 and 0.2*M* excess H_3BO_3, and agitated the solution for twenty hours with freshly precipitated nickel carbonate to secure complete neutralization, but did not record the nickel concentration of the resultant solution. As pointed out in a paper on lead fluoborate solutions[9], there is a great need for study of the constitution of fluoboric acids and fluoborates.

In view of the uncertainty as to the constitution of the nickel fluoborates which are almost certainly present in these solutions, it is most satisfactory to express the composition of the solutions employed in terms of the amount of the constituents actually used in their preparation. Thus if a solution is stated to be 1.8*N* in nickel sulphate, 0.2*N* in nickel fluoride and 0.5*M* in boric acid, it was prepared by treating an amount of hydrofluoric acid equivalent to a final concentration of 0.2*N*, with an excess of nickel carbonate, and after all reaction had ceased, by adding the requisite amount of boric acid. This mixture was added to the nickel sulphate solution, and thoroughly mixed. After standing for several hours, the solution was filtered. By this method of preparation the solutions were made as nearly neutral as possible, as they were at all times in contact with nickel carbonate and nickel hydroxide. This procedure was employed at first because it was desired to obtain solutions containing no other metal than nickel. As will be explained later, it is far simpler to prepare solutions by the use of sodium fluoride, which solutions are very similar in behavior to those made from nickel fluoride.

Methods of Analysis

For satisfactory experimentation or commercial application of plating solutions, it is essential to have reliable methods of analysis. In solutions containing nickel, fluorides and boric acid there is no difficulty in determining the nickel content by the usual electrolytic methods. The estimation of fluorine and of boric acid is, however, very difficult, and at present we know of no entirely satisfactory methods for fluorine, and no methods whatever for the boric acid in such solutions.

The determination of fluorine by precipitation as calcium fluoride is at best a tedious method, owing to the difficulty of retaining the calcium fluoride upon a filter. If calcium carbonate, or, as has recently been proposed, calcium oxalate,[10] is precipitated along with the calcium fluoride, the precipitate may be retained on a filter, but the filtration and washing still require a long period. In order to apply such a method to the plating solutions it would be necessary to remove the sulphate, and moreover the presence of boric acid would cause uncertainty in the composition of the final precipitate. These difficulties were found to be so great that after numerous attempts the gravimetric estimation of fluorine in these solutions was abandoned.

Approximate results have been obtained by a simple volumetric method which was first proposed by A. Greef.[11] It depends upon titration of the neutral fluoride with standard ferric chloride solution, which forms a precipitate having the formula Na_3FeF_6 analogous to cryolite. In order to repress the solubility of this salt, sodium chloride is added in large excess. Sodium sulphocyanate is used as the indicator and a layer of ether is employed to extract and concentrate the ferric sulphocyanate formed when the ferric chloride is present in slight excess. The end point is reached when a permanent faint pink color is produced in the ethereal layer. The details for the application of this method to nickel solutions have not yet been perfected, but the indications are that the method will be sufficiently accurate for plant control.

Estimation and Control of Acidity

Of even greater importance than the determination of the major constituents of a nickel-depositing solution are the estimation and control of the acidity, or, more strictly speaking, of the hydrogen ion concentration of the solution. In nickel deposition in general and especially in the accurate reproduction of engraved plates, the most common difficulties encountered are "pitting" and "cracking" or "curling." Even though there may be other contributing factors, it seems reasonably certain that the principal cause of such defects is excessive acidity of the solutions, or at least excessive liberation of hydrogen at the cathodes. In discussing the cause of pits it is necessary to distinguish between them and projections, which latter are usually initiated by the presence in the solutions of suspended conducting particles such as nickel and carbon derived from the anodes. Before any really conclusive evidence can be obtained, however, as to the cause and prevention of pitting and cracking, means must be secured for measuring and controlling the acidity of such solutions.

The hydrogen ion concentration of a solution may be expressed directly in the following form: $(H^+) = 10^{-6}$; which signifies that the actual concentration of hydrogen ions in the solution is $\frac{1}{1{,}000{,}000}$ normal. In order to avoid the use of the negative exponent, S. P. L. Sörensen[12] employed the log $\frac{1}{(H^+)}$ to which value he applied the expression p_H. Thus in the above case $p_H = 6$. In using this method of expression it is necessary to bear in mind that a large numerical value for p_H represents a low hydrogen ion concentration or acidity, and *vice versa*. A detailed discussion of methods of measuring and expressing the hydrogen ion concentration will be found in a recent book by W. M. Clark.[13]

Methods of Testing Acidity of Solutions

Various methods for testing the acidity of nickel-plating solutions have been proposed and employed to

[8] *Bull.* Soc. d'Encour, 1912.
[9] *Trans.* Amer. Electrochem. Soc. (1919), vol. 36, p. 243.
[10] Edminster and Cooper, *J. Am. Chem. Soc.*, 1920, vol. 42.
[11] *Ber.* (1913), vol. 46, p. 2,511.
[12] *Compt. rend. Lab. Carlsberg* (1909), vol. 8, p. 1.
[13] "The Determination of Hydrogen Ions," Williams & Wilkins, Baltimore, Md., 1920.

advantage in plant control. The simplest is the testing of the solution with litmus and congo-red papers, which, it is frequently claimed, should both be turned pink by a solution in good operating condition—i.e., the solution should be acid to litmus and alkaline to congo-red. In measurements depending upon the actual titration of nickel solutions the most common indicator thus far employed is sodium alizarin-sulphonate. A solution is said to be satisfactory if a given sample requires a certain amount of acid or of alkali to produce a neutral (or some definite) tint with this indicator.

These two methods illustrate the measurement of two distinct factors in the acidity of such a solution—viz., the intensity and the quantity factor. The first method measures, at least roughly, the hydrogen ion concentration; the second determines the amount of acid or of alkali required to produce some definite hydrogen ion concentration. Either method may be useful, but both are necessary to a complete understanding of the behavior of such a solution during operation.

Application of Hydrogen Ion Measurements

The application of hydrogen ion measurements should prove very valuable in determining not only the optimum range of acidity for nickel deposition, but also the possible function of various additions, such as fluorides and boric acid, in regulating this acidity. In such measurements it is important to determine not alone the p_H of solutions of certain composition, but also the rate at which the p_H changes upon the addition of acid or alkali, since this rate determines the degree to which the solution will automatically compensate for any variation in anode or cathode efficiency. So far as acidity is concerned, the ideal nickel-plating solution is one which will within the desired working range have a relatively flat neutralization curve; in other words, it should be a well "buffered" solution. Much work remains to be done on this subject, as it will require the laboratory study of many solutions and the correlation of such results with the operation of corresponding baths over long periods. The observations thus far made by us are distinctly preliminary.

Since the hydrogen ion concentration of these solutons appears to be directly related to their behavior upon electrolysis, attempts were first made to measure this property by means of the hydrogen electrode. Even with pure nickel sulphate solutions, however, the results were not consistent or reproducible. Frequently values would be obtained which appeared to be definite, but with another electrode appreciably different values were secured. The results were still less reliable when the commercial plating solutions were thus tested. This latter difficulty is probably attributable to the presence in commercial solutions of small amounts of copper, iron or arsenic, which may "poison" the electrodes. The difficulty with pure nickel sulphate cannot be readily explained. The only conclusion that could be reached from hydrogen electrode measurements conducted at different times during the past several years is that normal nickel sulphate solution has a p_H value between 6 and 7—i.e., the hydrogen ion concentration (H^+) is between 10^{-6} and 10^{-7}—and that satisfactory plating solutions have a p_H value between 4 and 6.

"Drop Method" Test for Hydrogen Ion Concentration

More satisfactory results have been obtained by measuring the hydrogen ion concentration with indicators, using the "drop method" as proposed by L. J. Gillespie[14] and also described in detail by W. M. Clark.[15] In this method, instead of preparing hydrogen ion standards by the use of buffered salt solutions, tubes containing different fixed proportions of the given indicator in its acid and alkaline form are placed in pairs so that the color observed by transmitted light is that of a partly transformed indicator, corresponding to some known p_H. When the test solution is colored as with nickel solutions, it is necessary to include in each series of standards a third tube containing the nickel solution. A definite quantity of indicator is then added to a separate portion of the nickel solution, two tubes containing water are placed in series with it, and the resultant color is matched against the indicator color standards as above prepared. The indicators which have been found most useful in measurements upon nickel solutions are bromphenol blue, and bromcresol purple, which together cover the range involved—i.e., p_H = 3.5 to 7.0. At first methyl red appeared to be well suited for this purpose, since it is very sensitive in the region from p_H = 4.0 to 6.0; but careful measurements showed that

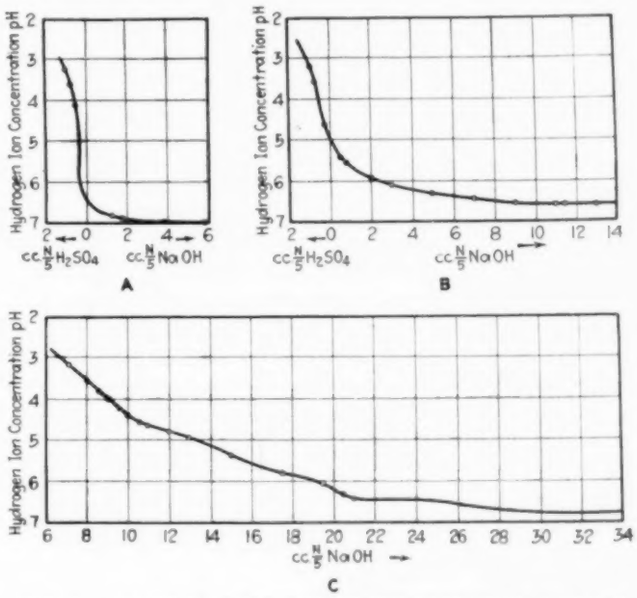


FIG. 1. HYDROGEN ION AND NEUTRALIZATION CURVES OF NICKEL SOLUTIONS

Based on colorimetric measurements upon 50 c.c. of solution. Initial composition:
A: $NiSO_4$ — N.
B: $NiSO_4$ — N; H_3BO_3 — 0.5M.
C: $NiSO_4$ — N; H_3BO_3 — 0.5M; HF — 0.1N.

in nearly neutral nickel solutions anomalous results are obtained with this indicator, presumably because of some specific salt effect. Preliminary observations with indicators show that the p_H of normal nickel sulphate solutions is about 6.8, and that the addition of even very minute amounts of acid causes a great increase in acidity, that is, a decrease in p_H.

In Fig. 1, *A* is a typical "titration curve" of nickel sulphate—i.e., it represents the changes in hydrogen ion concentration produced by successive additions of acid or of alkali. This curve, based on measurements with indicators, has the same shape and approximately the same position as one which was obtained with the hydrogen electrode; in the latter case, however, the readings were somewhat uncertain and erratic. The large

[14] *J. Am. Chem. Soc.* (1920), vol. 42, p. 742.
[15] "The Determination of Hydrogen Ions," by W. M. Clark (Williams & Wilkins, 1920).

effect upon the hydrogen ion concentration produced by the addition of small amounts of sulphuric acid to nickel sulphate solutions indicates clearly why it is not practicable to deposit nickel from a solution containing only nickel sulphate, as even slight deficiency in anode corrosion will result in such a large increase in hydrogen ion concentration as to cause a low cathode efficiency and a poor deposit. Bennett[16] and his associates found that the cathode efficiency in a "neutral" nickel ammonium sulphate solution was low, but that by the addition of small amounts of ammonia to the solution the cathode efficiency approached 100 per cent. They did not, however, make any measurements of the change in hydrogen ion concentration thus produced.

The effect of boric acid in maintaining a uniform slight acidity of a nickel bath is shown in Curve *B* of Fig. 1. Let us assume, as a first approximation, that a satisfactory nickel bath should have a p_H between 4 and 6 (actually the range may be much narrower). By comparison of curves *A* and *B*, it is seen that in 50 c.c. of a normal nickel sulphate solution it requires less than 0.5 c.c. of *N*/5NaOH to change the p_H from 4 to 6, whereas, in the solution containing boric acid it requires about 2.5 c.c. of the alkali to produce the same change in p_H. This observation confirms the conclusion of L. D. Hammond[17] that the principal function of boric acid in nickel baths is the maintenance of a uniform low hydrogen ion concentration. Upon reversal of the neutralization process—i.e., the addition of acid to a solution made slightly alkaline with sodium hydroxide—a curve of similar shape is obtained. If, however, nickel hydroxide has been actually precipitated by the alkali, there is a certain "lag" in its solution by the acid, which causes the solution at any stage to be more acid (a lower p_H) than corresponds to the true equilibrium. This lag is very much less if boric acid is present than in the simple nickel sulphate solution.

Curve *C* of Fig. 1 illustrates the effect of the addition of alkali to a nickel solution containing both hydrofluoric and boric acids. It is apparent that the reaction is complicated and that considerable further study will be required to explain the significance of each part of the curve. It is evident, however, that the solution is "well buffered"—i.e., the p_H does not change as rapidly upon the addition of alkali as it does in the pure nickel sulphate solution or in that containing only boric acid. To produce the same change as above considered—viz., p_H = 4 to 6—it requires about 10 c.c. of the 0.2*N* alkali—i.e., four times as much as in the solution with boric acid, and over twenty times as much as in pure nickel sulphate solutions. Whether this marked regulating effect of the fluorides or fluoborates is the principal cause of their effect upon the structure of the deposits must be determined by more exhaustive experiments.

It is significant that in all three curves the p_H at the point where nickel hydroxide begins to precipitate (and beyond which the p_H changes very slightly until all the nickel is precipitated) is about 6.8—i.e., nearly the same as the neutral point of nickel sulphate. This shows that when these solutions are neutralized by agitation with nickel hydroxide, they all reach the same degree of neutrality. A few experiments indicate that the same p_H is obtained by neutralizing the solutions with nickel carbonate.

[16] C. W. Bennett, H. C. Kenny and R. P. Dugliss. *Trans.* Amer. Electrochem. Soc. (1914), vol. 25, p. 335.

[17] *Trans.* Amer. Electrochem. Soc. (1916), vol. 30, p. 103.

Experiments Upon the Operation of Solutions

Most of the experiments upon these solutions were carried out at the Bureau of Standards. Observations were also made upon solutions in operation at the Bureau of Engraving and Printing. Small-scale experiments were conducted in glass battery jars containing from 1 to 10 liters and in stoneware tanks with a capacity of about 30 liters. Within short periods there was practically no etching of the glass or stoneware by the solutions containing fluoborates. For continuous operation it is probably best, however, to line stoneware vessels with a bituminous coating, since it has been found that when lead fluoborate solutions are kept in stoneware for a year or more there is decided etching. For factory operation of these solutions both the stoneware and wooden tanks have been lined with bituminous material. There is no appreciable contamination of the solutions when kept in chemical glassware during analysis.

For purposes of comparison the fluoborate baths were usually run in series with a nickel bath similar to that recommended by O. P. Watts,[18] but in order to permit a ready comparison between the function of the chlorine and fluorine, Watts' formula was slightly modified to yield definite normalities. See Table I.

TABLE I. FORMULA OF "CHLORIDE" SOLUTION. BATH NO. 2

		g/L	Oz./Gal.
Nickel sulphate	1.8 *N*	255	34
Nickel chloride	0.2 *N*	24	3.2
Boric acid	0.5 *M*	31	4.2

Corresponding "fluoride" baths were prepared, of which, however, the compositions are not strictly equivalent to that of the chloride bath, since, as previously noted, some nickel hydroxide separates out upon mixing nickel fluoride and boric acid. The constituents actually used in their preparation are shown in Tables II-A and II-B.

TABLE II-A. FORMULA OF "FLUORIDE" SOLUTION

		g/L	Oz. Gal.
Nickel sulphate	1.8 *N*	255	34
Nickel carbonate[19]		12	1.6
Hydrofluoric acid[19] (50 per cent HF)		8	1.1
Boric acid	0.5 *M*	31	4.2

TABLE II-B. FORMULA OF "FLUORIDE" SOLUTION

		g/L	Oz. Gal.
Nickel sulphate	2.0 *N*	281	37.5
Sodium fluoride	0.2 *N*	8.4	1.1
Boric acid	0.5 *M*	31	4.2

The solution given in Table II-A is prepared by adding the hydrofluoric acid cautiously to the nickel carbonate which has been previously mixed with water to the consistency of a thick cream. After effervescence ceases, the boric acid, first dissolved in warm water, is added, and the entire mixture is then added to the solution of the nickel sulphate. After thorough mixing the solution is filtered or allowed to settle.

The solution given in Table II-B is prepared simply by dissolving the three constituents in water. By using warm water, solution occurs more rapidly.

A few preliminary experiments were made with nickel fluoborate without sulphate and with solutions containing 50 per cent of the nickel as fluoborate and 50 per cent as sulphate; but the deposits obtained were less satisfactory than those with the above solution in which approximately 10 per cent of the nickel is present as fluoborate. Most of the studies were therefore

[18] *Trans.* Am. Electrochem. Soc. (1916), vol. 29, p. 125.

[19] Equivalent to 0.2*N* nickel fluoride.

conducted with the latter solutions. A few experiments with solutions containing only nickel sulphate and nickel fluoride yielded unsatisfactory deposits.

In general the solution to be studied was run in series with the "chloride" bath and with a copper voltameter (coulometer). In most cases deposition was produced upon polished steel plates which had been treated with sodium sulphide solution to permit subsequent separation of the deposited nickel.

Where physical tests of the deposits were to be made, the steel plates were surrounded with a shield of insulating material ("Formica") which served to reduce the current density and thickness over the entire surface.

Through use of a shield it was also possible to employ entire higher average current densities than otherwise, as under ordinary conditions the edges receive an excessive current density and become cracked or "burnt."

Unless otherwise noted, commercial "95-97 per cent" cast nickel anodes having an area approximately equal to the cathodes were employed. An analysis of one lot of these anodes[20] yielded the results given in Table III.

TABLE III. COMPOSITION OF NICKEL ANODES

	Per Cent
Nickel (+ cobalt)	97 5
Carbon	1 50
Silicon	0 05
Copper	0 20
Iron	0 60
	99 85

In a few cases commercial anodes having almost the same conposition, except that they contained 0.6 per cent of tin, were used, with no apparent difference in the operation of the baths.

Physical Properties of Deposited Nickel

As our immediate interest was in securing deposits which would withstand severe abrasion, greater attention was paid by us to the physical properties than to the appearance of the deposits. Pending the development of a satisfactory method for measuring hardness, and especially the "abrasion hardness" of thin layers of metal, a few preliminary tensile tests were made[21] upon the assumption that the results would at least indicate the relative hardness of samples of similar material. The results obtained upon relatively thick specimens (about 0.75 mm. or 0.03 in.) are given in Table IV.

TABLE IV. PHYSICAL PROPERTIES OF DEPOSITED NICKEL

Expt.	Solution	Current Density Amp./sq.dm.	Amp./sq.ft.	Ultimate Tensile Strength Kg./sq.cm.	Lb. sq.in.	Elongation in 2 in. (5 cm.) per cent
1	Chloride No. 2	1	9	4,900	75,000	
2	Chloride No. 2	3	28	4,900	75,000	8 5
3	Chloride No. 3	5	47	5,600	80,000	11 0
4	Fluoride No. 3	1	9	7,000	100,000	
5	Fluoride No. 3	3	28	8,200	117,000	2 4
6	Fluoride No. 3	5	47	9,350	133,000	4 8

Accurate determination of the yield points was not found possible, but the few results obtained indicate that there is less difference in the yield point than in the ultimate tensile strength of the nickel from the two solutions. The data in Table IV show that there is a great difference in the ultimate tensile strength of the deposits from the chloride and fluoride solutions, which difference is most marked in deposits produced at relatively high current densities. This difference can be readily observed by manual bending of the samples, when it will be found that the fluoride deposits are much stronger and more elastic than the chloride.

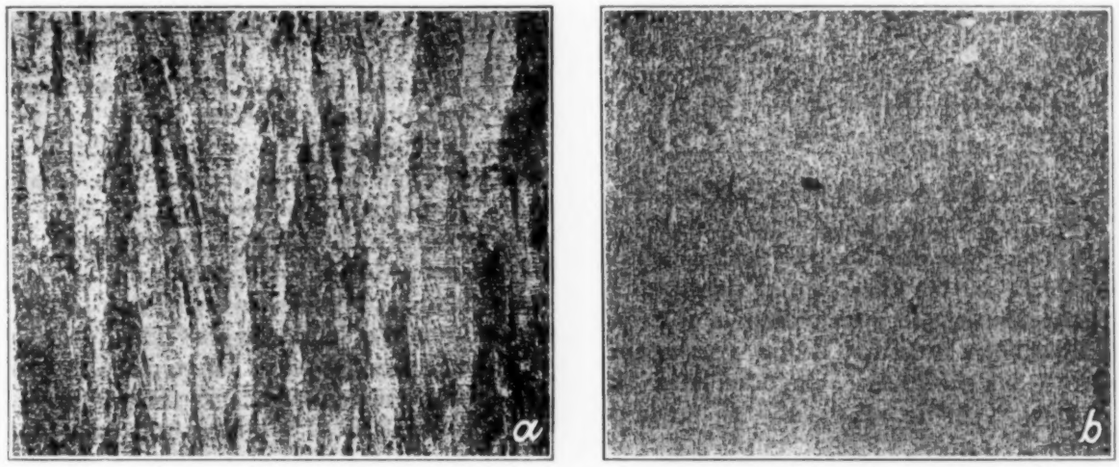


FIG. 2. STRUCTURE OF ELECTRODEPOSITED NICKEL. × 100
a—"Chloride" solution, 5 amp./sq.dm. (47 amp./sq.ft.). *b*—"Floride" solutions, 5 amp./sq.dm. (47 amp./sq.ft.)

It has not been possible to secure any absolutely conclusive evidence of the relative wearing qualities (e.g., on a printing press) of the two grades of nickel, but all the evidence secured confirms the superiority of the fluoride deposit for this purpose.

That this difference in physical properties is accompanied by differences in crystal structure is evident from Fig. 2, from which it will be seen that the deposit from the fluoride is much finer grained than that from the chloride solution.

TABLE V. COMPOSITION OF DEPOSITED NICKEL

	"Chloride" Per Cent	"Fluoride" Per Cent
Nickel (+ cobalt)	99 60	99 40
Iron	0 27	0 45
Copper	0 09	0 15
	99 96	100 00

One of the most characteristic differences in the operation of baths containing chlorides and fluorides is the fact that much sludge is produced in the chloride solution, while the fluoride remains practically clear. Under these conditions we would expect a higher content of metallic impurities in the fluoride deposit than in the chloride, in fact the presence of such impurities has

[20] By J. A. Scherrer, of this bureau.
[21] By L. B. Tuckerman, of this bureau.

been suggested as a cause of the finer crystal structure and higher tensile strength of the fluoride deposit. Analysis of the deposits[22] yielded the results shown in Table V.

Even though there is a greater content both of copper and iron in the fluoride deposit (approaching closely that present in the anodes), it is at least doubtful whether these amounts of impurities could account for the difference in structure and physical properties, especially since they are present in at least comparable amounts in the chloride deposit. Further experiments are needed to determine whether the effect of the fluorides or fluoborates is specific, or whether similar effects may be produced by other substances.

Experiments With Hot-Rolled and Electrolytic Nickel Anodes

In view of the good anode corrosion in the fluoride solutions, and the almost complete absence of sludge, a few attempts were made to employ either hot-rolled or electrolytic nickel anodes.[23] These experiments indicated that the fluoride solution corrodes the rot-rolled anodes about as readily as it does the cast anodes, but that the corrosion of the electrolytic anodes is poor until the solution becomes so acid that a very low cathode efficiency is secured. Further work will be required to determine whether the commercial use of rolled anodes in these solutions will prove practicable and economical.

The rolled anodes used in these experiments had the composition given in Table VI.[24]

In both the chloride and fluoride solutions it was found that the cathode efficiency for current densities up to 2 amp. per sq.dm. (19 amp. per sq.ft.) is above 99 per cent. At higher current densities the cathode efficiencies are slightly lower in the chloride than in the fluoride solutions. It is possible to use higher current densities in the fluoride than in the chloride solutions, without producing appreciable cracking or curling of the deposit. Thus on polished brass plates about 6 x 9 cm. (2.5 x 3.5 in.) good adherent deposits were obtained from both solutions at an average of 2 amp. per sq.dm. (19 amp. per sq.ft.), while at 4 amp. per sq.dm. (37 amp. per sq.ft.) the deposit from the fluoride was almost perfect, and that from the chloride was badly curled. These data are of only relative value, however, as the actual current density upon the edges, where cracking first occurred, was certainly much higher than the above values. The deposits referred to in Table V as secured at a current density of 5 amp. per sq.dm. (47 amp. per sq.ft.), were rendered possible only by the use of the shields.

As for the immediate purpose in view it was necessary to use wax for insulating purposes, the use of solutions at appreciably elevated temperatures was prevented. All of the experiments herein described were made with solutions at room temperature (20 to 25 deg. C., or 68 to 77 deg. F.). The effects of bath temperature upon the deposits will be included in the further investigations now in progress.

Conductivity of Plating Solutions

One of the important factors in the operation of plating solutions is the conductivity, because an increase in conductivity not only represents an economy in power, but also leads to the production of smoother deposits. In this respect the fluoride solution as above prepared is slightly inferior to the chloride as shown by the data in Table VII based on approximate measurements at 25 deg. C. (77 deg. F.).

TABLE VI. COMPOSITION OF HOT ROLLED-NICKEL ANODES

	Per Cent
Nickel	98.50
Iron	0.64
Copper	0.17
Carbon	0.05
Manganese	0.35
	99.71

TABLE VII. RESISTIVITY OF NICKEL SOLUTIONS

No.	Composition		Resistivity Ohms per Cm. Cube
1	$NiSO_4$	2.0*N*	20.5
2	$NiSO_4$	1.8*N*	
	$NiCl_2$	0.2*N*	19.8
	H_3BO_3	0.5*M*	
3	$NiSO_4$	1.8*N*	
	NiF_2	0.2*N*	21.9
	H_3BO_3	0.5*M*	
4	$NiSO_4$	1.8*N*	
	NiF_2	0.2*N*	
	H_3BO_3	0.5*M*	17.2
	Na_2SO_4	0.5*N*	
5	$NiSO_4$	1.8*N*	
	NiF_2	0.2*N*	
	H_3BO_3	0.5*M*	20.9
	$MgSO_4$	0.5*N*	
6	$NiSO_4$	2.0*N*	
	NaF	0.2*N*	19.9
	H_3BO_3	0.5*M*	

Efforts were therefore made to increase the conductivity by the addition of sodium sulphate and magnesium sulphate respectively. It is interesting to note (Table VII) that the sodium sulphate has a greater effect upon the conductivity than has an equivalent amount of magnesium sulphate, though the change produced by this concentration of either is not sufficient to represent any great economic advantage. Unfortunately, there is no prospect for the development of a good nickel-depositing solution with a resistivity comparable with that of the acid copper bath (about 5 ohms per cm. cube).

A few experiments with solutions corresponding to Nos. 4 and 5 in Table VII showed that good deposits could be secured in them, within about the same range of current density, as in No. 3. No physical tests were made upon the deposits, but from simple bending tests they appeared to be somewhat "softer" than the deposits from No. 3. At the same time it was found that there was slightly less tendency for the deposits from Nos. 4 and 5 to crack and curl up than for the deposits from No. 3. The advantages observed were not sufficient, however, to justify a definite recommendation to add these "conducting salts" to the solution.

One of the chief objections to the use of solutions prepared like No. 3 is the danger and inconvenience of handling hydrofluoric acid. In our later experiments, therefore, a bath was prepared according to the formula of No. 6 (Table VII). The substitution in No. 3 of sodium fluoride for nickel fluoride, with the addition of an equivalent amount of nickel sulphate, should produce a solution exactly similar to that which would be secured by adding 0.2*N* sodium sulphate to No. 3. The value for the conductivity of such a solution and its behavior upon electrolysis indicates that such is the case. This bath has not been used by us on a commercial scale for so long a period as has No. 3, but the results thus far obtained are sufficiently promising to recommend its further application. Apparently, the de-

[22] By J. A. Scherrer, of this bureau.
[23] Furnished for this purpose by the International Nickel Co.
[24] Analysis by J. A. Scherrer.

posits are slightly softer than those from No. 3, which may cause somewhat less resistance to abrasion. On the other hand, such deposits may be preferable in electroplating because they are more readily buffed. A bath of this character has been used by us for miscellaneous plating for a few months, and has given entirely satisfactory results.

Conclusions

When nickel or sodium fluoride is added to nickel baths containing boric acid, fluoborates more complex than those corresponding to the formula HBF_4 are probably produced. The fluorine content of such solutions can be determined approximately by titration with ferric chloride.

The effect of boric acid and hydrofluoric acid upon the hydrogen ion concentration and neutralization curve of nickel sulphate solutions has been studied, and their function in plating solutions has been suggested.

Nickel deposits produced in solutions containing fluorides have a finer structure and a higher tensile strength than those produced in corresponding chloride solutions. When prepared with anodes containing about 97 per cent of nickel, there is slightly more iron and copper in the fluoride deposits than in the chloride.

The anode corrosion in solutions containing fluorides is good and the solutions produce less sludge than do corresponding chloride solutions. Attempts to use electrolytic anodes in such solutions at reasonably high current densities have not yet been successful, but the results with hot-rolled anodes are promising.

The use of fluorides in nickel solutions for electrotyping will probably increase the wearing quality of the printing surface. In electroplating, good deposits can be secured in the presence of fluorides at somewhat higher current densities than are ordinarily employed, and these deposits, while slightly harder to buff, show greater resistance to abrasion.

The use of the solution given in Tables II-A and II-B is suggested. These solutions may be used with an average current density of from 3 to 4 amp. per sq.dm. (28 to 37 amp. per sq.ft.) for producing adherent deposits in electroplating and 1.5 to 2 amp. per sq.dm. (14 to 19 amp. per sq.ft.) for making reproductions, as in electrotyping.

Acknowledgment

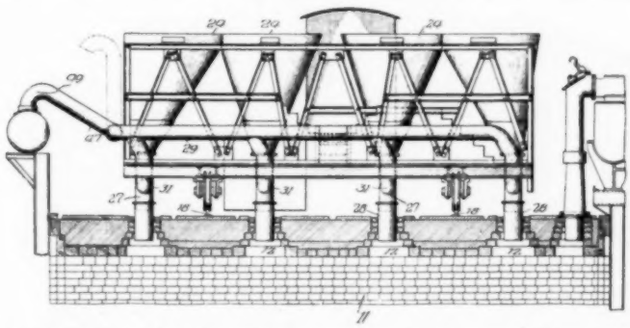
The author desires to express his appreciation for the assistance of his associates at the Bureau of Standards, especially W. E. Bailey, L. D. Hammond, H. E. Haring and M. R. Thompson, in conducting the experiments described in this paper.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Coke-Oven Charging Car and Means of Discharging Smoke.—John Becker of Pittsburgh, Pa., has patented an improved device for charging coke ovens which also provides an effective means for taking care of the smoke ordinarily escaping into the open air at the time of charging. The charging car shown in the accompanying drawing permits the coking chambers of a battery of ovens to be charged independently of each other while at the same time the openings of the ovens are collectively connected to a fixed smoke main extending longitudinally along the battery. The smoke



incidental to the charging operation is conveyed from the coking chambers 11 through the openings 12. The charging car, consisting of the four funnel-shaped hoppers 24, can be moved across the several batteries of coking chambers on the tracks 18. The hoppers are normally closed by a slide located at the top of the chute 27. The smoke flue 29 is carried with the truck, and its branches 31 extend into the sides of the chutes. The action of recharging consists briefly in connecting the smoke flue with the main and then lowering the sleeves 28. The coal, which is charged from one or more of the hoppers, causes the smoke to be delivered out of the other charging openings into the smoke flue 29 (1,376,313, April 26, 1921.) Another patent (1,376,314, April 26, 1921) provides a means for discharging the smoke into a gas-collecting main so that, if desired, the byproducts carried along with the gas can be recovered.

Process of Treating Brass Scrap.—Oliver C. Ralston has discovered that aluminum, iron and other metals which are electropositive to copper can be removed from brass scrap and related copper-bearing alloys by treating these materials with an aqueous solution of cupric chloride or with a weak hydrochloric acid solution into which chlorine gas is introduced. Starting with a brass scrap containing 35 per cent of zinc and 0.2 per cent of iron, the contents of these metals were reduced to 10 per cent and 0.05 per cent respectively, and the total loss of the charge did not exceed 48 per cent. (1,375,930; April 26, 1921.)

Refractory Material.—Carborundum refractory articles can be made satisfactorily by using a bonding material composed of zirconium and aluminum silicates. Carborundum constitutes at least 80 per cent of the mixture, which is held together by a bond consisting of 9 parts of zirconium silicate to 1 part of aluminum silicate. The principal advantages possessed by this bonding material are the long and higher vitrification range and its desirable surface reaction with the carborundum. (1,376,091; Miner L. Hartmann, of Niagara Falls, N. Y., assignor to the Carborundum Co.; April 26, 1921.)

Alloys for High-Speed Tools.—Alloys consisting essentially of chromium, tungsten, cobalt, carbon and iron have been found to be especially useful for the manufacture of lathe tools and other instruments operated at great speed. These alloys, it is claimed, possess the requisite qualities of toughness, hardness and ductility in a high degree and would therefore be preferred to alloys which are so hard as to be brittle and easily broken or which are so soft that they will not withstand the great pressure under which they are operated. (1,376,056 and 1,376,062; John F. Wandersee, Robert Peretto, and Theodore Albrecht, assignors to the Ford Motor Co.; April 26, 1921.)

Production of a Ferro-Silico-Magnesium Alloy.—An alloy to be used as a deoxidizing agent is prepared by adding magnesium to ferrosilicon, which has been heated to a semi-fluid state. Aluminum, nickel or other metals may be alloyed with magnesium and used as a substitute for it, provided they are added to the ferrosilicon in the same

manner. (1,376,113; GUSTAV PISTOR, ALBERT BEIELSTEIN, and ADOLF BECK, assignors to the Chemische Fabrik Griesheim-Elektron of Frankfort, Germany; April 26, 1921.)

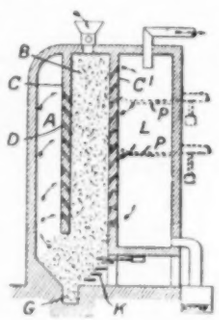
Nitrogen Fixation Process.—A method is proposed for producing compounds such as ammonia and the oxides of nitrogen by gas reactions within an electrolytic cell. Advantage is taken of the activity of electrolytic oxygen and hydrogen by bringing nitrogen into intimate contact with them at the time of their liberation. This is accomplished by the use of porous anodes and cathodes into which a stream of nitrogen is forced. (1,376,207; CHARLES B. JACOBS, assignor to E. I. du Pont de Nemours & Co. of Wilmington, Del.; April 26, 1921.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Calcium Superphosphate.—A soluble calcium phosphate or a manure containing it in admixture with potassium sulphate is prepared by calcining alunite and passing the gaseous products into a tower or chamber containing phosphate with or without calcined alunite, water spray or steam being added if necessary. The calcination of the alunite may be effected in a closed retort at 700-900 deg. C. or in a furnace in which it descends over a number of hearths, the lower ones being externally heated to 700-900 deg. C. The reactions are completed on storing the product. According to the provisional specification, the gases arising from the calcination of alunite may be led over calcined alunite for the production of aluminum sulphate and alum; and a fertilizer containing soluble phosphate and potash is obtained by calcining as above described a mixture of alunite and insoluble phosphate. (Br. Pat. 158,293; A. MATHESON, London. April 13, 1921.)

Gas Producers.—In the continuous distillation of carbonaceous material by passing therethrough streams of hot gas, the volatile products are collected in a chamber provided with one or more outlets for gases, vapors and liquid distillates. The fuel may be fed continuously to the preheating chamber *B* of a producer provided with a grate *K* at the base, and ash is discharged continuously by a screw *G*. The producer gas passes into a distributing chamber *A* and through a louvered partition *D* into the fuel. The gases, etc., escape through a second partition *C*¹ into the collecting-chamber *L*, which may be divided by shelves *P* to fractionate the products. In one modification, three concentric chambers are used, and in another form, the producer is separated from the distillation chamber. (Br. Pat. 158,394; W. P. PERRY, London. April 13, 1921.)



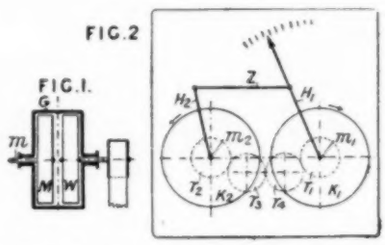
Dyeing Cellulose Acetate.—In dyeing fibers, threads or fabrics of cellulose acetate, the material is treated with ammonium thiocyanate prior to dyeing, or ammonium thiocyanate is added to the dye-bath. Instead of ammonium thiocyanate, sodium, potassium, calcium, etc., thiocyanates may be used. Examples are given of dyeing with acid wool dyes, basic dyes, substantive cotton dyes, and vat dyes. Mixed goods containing cellulose acetate and cotton, wool, silk, etc., may be treated by the process, either by cross-dyeing or by using a dye which the two fibers absorb in the presence of the thiocyanate. (Br. Pat. 158,340; BRITISH CELLULOSE & CHEMICAL MANUFACTURING CO., LTD., Westminster, and J. F. BRIGGS and C. W. PALMER, both of Spondon, near Derby. April 13, 1921.)

Catalytic Iron.—Pure iron, which is useful as a catalyst for the synthesis of ammonia, is prepared by treating ferric nitrate solution with just sufficient silver nitrate to precipitate any chloride present, filtering, evaporating the solution to dryness, partly converting the nitrate into oxide by gentle ignition, washing out the residual nitrate together with any oxidized sulphur product, and finally reducing the ferric oxide. An inert support, such as pumice or asbestos, may be added just prior to ignition; and a promotor may be incorporated with the catalyst by adding ammonium molybdate, potassium osmate, titanium nitrate, uranium nitrate or an alkali tungstate, to the purified ferric oxide before reduction. The product is preferably heated in pure ammonia gas. (Br. Pat. 159,960; NITRO-FIXATION SYNDICATE, LTD., and H. C. JENKINS, London, May 4, 1921.)

Gas Density Estimating Apparatus.—The density of a gas is determined by rotating a solid body in a chamber containing the gas and causing the current of gas thus set up to act on a second movable solid body which operates an indicating device. In the form shown in Fig. 1 the rotating member *W* is disposed in the chamber *G*, which also contains the member *M*, which is displaced by the gas current. The latter

FIG.2

FIG.I.

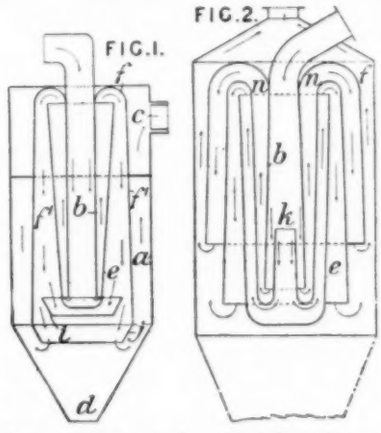


member is mounted on a shaft *m* to which a pointer, etc., is connected. The form shown in Fig. 2 comprises two similar chambers K_1, K_2 respectively containing the gas to be tested and the standard gas such as air. The rotating parts are connected by gearing $r_1 \ldots r_4$ so as to turn at equal speeds in opposite directions. The shafts m_1, m_2 carry arms H_1, H_2 connected by a link *Z*, and a pointer on the arm H_1 indicates the relative densities of the gases. (Br. Pat. 159,845; not yet accepted; G. KONIG DAHLEM, Berlin, May 4, 1921.)

Dust Collectors.—Relates to apparatus for separating dust from air and gases and of the type in which the separation is effected in stages within a vessel containing a conical hood, the air impinging upon the inner surface of the hood and having its direction changed and its velocity reduced as it passes through the vessel, and consists in the provision of additional conical hoods, within the vessel. As shown, the air-inlet pipe *b*, Fig. 1, communicates with the interior of the container *a* having an air outlet *c* which may be connected with a suction device, and a dust outlet *d*. A conical hood *e*

FIG.I.

FIG.2.



closed at its lower end encircles the inlet pipe, and a hood *f* having a conical depending skirt *f*¹ is fitted at the upper and open end of the hood *e*. Baffle-plates *i*, *j* are provided within and at the lower portion of the skirt to reduce the velocity of the air. In a modification, the cover at the lower end of the hood *e* is replaced by a dust-pipe extending through the lower portion *a*¹ of the container and closed by a removable cap. In another arrangement, the inlet pipe *b*, Fig. 2, is tapered, and the air current entering the container is subdivided by a hood *k*, having an open and upwardly extending central portion which communicates with a hood *e*. The subdivided air currents pass through passages formed in the container by means of hoods *f*, *n*, and finally unite before leaving. (Br. Pat. 160,100; R. BOBY, LTD., and M. JENNINGS, Bury St. Edmunds. May 11, 1921.)

Synopsis of Recent Chemical & Metallurgical Literature

Length Changes at Transformation Points.—Simple experiments showing the dilation of steel wires have been described by J. LEMOINE and M. GARVIN in *Revue Générale des Science*, April 15, 1920, p. 194. The accompanying figure shows schematically the results they have obtained. A 3.5 m. long, 1.5 mm. diameter nichrome wire was swung in a horizontal position between two supports and a 110-volt current passed through it. The wire elongates on heating so as to give a 25-cm. deflection. On cooling the wire regains the original horizontal position. A hard steel (piano) wire 1.2 mm. in diameter when treated in the same way expands during heating up to a deflection of about 15 cm. corresponding to the temperature of dark red, then

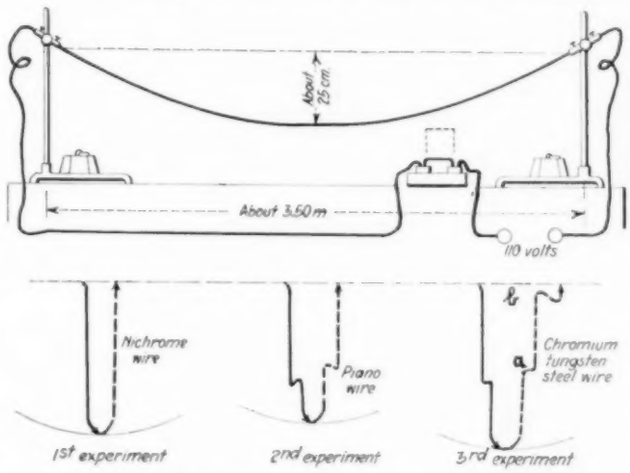


DIAGRAM SHOWING LENGTH CHANGES IN WIRES AT THEIR TRANSFORMATION POINTS

contracts a length corresponding to about 10 cm. deflection and finally elongates to about 20 cm. deflection at a temperature of cherry red. During cooling the wire contracts to a temperature below visible color, when it shows the phenomenon of recalescence and finally regains the original length. This experiment shows the well-known lag in transformation. A chromium-tungsten steel wire of the composition of high-speed tool steel, 3 m. long and 1.2 mm. in diameter, also gives instructive results. During heating a phenomenon similar to that for hard steel is observed, but at the temperature of bright red. During cooling two transformation points are observed. With slow cooling there would be only one transformation point corresponding to the first one at *a;* with rapid cooling there would also be only one, but this would correspond to that at *b*.

Research in Ceramic Decorative Processes.—The May *Journal* of the American Ceramic Society contains a clear analysis by FREDERICK H. RHEAD covering the fundamentals of research in ceramics. These fundamentals as outlined by Mr. Rhead consist of adequate resources, not only financial but mental and physical, which contribute to the success of the undertaking; a clearly defined purpose or program; efficient direction, experienced practical assistance, an adequate and well-planned equipment, and finally, educational facilities.

It will be generally conceded that the ideal condition will be that where the manufacturer and research director are in harmony as to the specific purpose of the activity. With the final program determined, working drawings would be executed and actual samples would be made. A competent director will commence work with as little disturbance as possible endeavoring to fit into the organization as it exists, while giving it new impetus. In this country we have architects, artists, draftsmen, sculptors and decorators of international reputation, and there is no practical reason why their interest should not be aroused and their services utilized.

As regards efficient direction, a progressive manufacturer with a knowledge of industrial possibilities should have little trouble in finding men capable of formulating and directing a program for the specific purpose in mind. The fact of the matter is that the average business man is afraid of the artist; calls him a freak; balks at his so-called temperament, entirely unconscious of the fact that the average business man is the most temperamental man in the world.

The art director and the director of artistic research must be an efficient executive with a sound knowledge of business principles, and the work of his department must be subject to the same rational business treatment and scrutiny and the same discipline accorded to the other branches of the activity.

It has just been stated that one man could not successfully carry out the work under discussion. An organization for the manufacture of artistic clay products may be compared to the symphony orchestra. Personal experience has shown that 35 per cent of the art director's time is spent in instruction. But it pays. An interested and enthusiastic working force is worth any amount of attention.

Speaking of adequate educational facilities, it might be suggested that the American Ceramic Society hold conventions where the program includes the general public. The various manufacturers would submit examples of their product; the school, examples of students' work. As far as possible each exhibit would be accompanied with a detailed classification of the process when school children are dabbling in pottery, when independent organizations such as the Apprentice Schools of Design and the Art Alliance are active in this direction. It is evidence of interest which could profitably be co-ordinated with the interests of the manufacturer.

If the American Ceramic Society is to establish a proper influence in the clay-working industry, the members as a body would be rationally sympathetic to those closely allied industries which in turn must be educated to an intelligent understanding of the tremendously important work being done by present-day industrial clay-working organizations. The work would be helped tremendously in this society if it were possible, at future conventions, to have a meeting of the heads of the various divisions. The decorative men need the assistance of the technicians, and both these groups cannot work without the practical men. And last, the manufacturer is an official whose attendance is absolutely necessary if the American Ceramic Society is to get very far with its program.

Recrystallization in Aluminum.—Prof. CARPENTER and Miss ELAM read a paper before the spring meeting of the British Institute of Metals on "Stages in the Recrystallization of Aluminum Sheet on Heating." They ascribe Brislee[1] and Anderson's[2] inability to detect crystalline structure in rolled aluminum to the fact that they examined the surface of the sheet. When cut, polished, etched and examined crosswise, laminar markings typical of drawn-out crystals were found. On reheating such sheet a long time at 220 deg. C., first evidence of structural change is shown in a general surface tarnish, a granular structure and a loss of definition at the original grain boundaries. After seventeen hours at 250 deg. C. and correspondingly shorter times at higher temperatures new white crystals appear at the old boundaries. Structural equilibrium attained after prolonged heating at such low temperatures gives crystals elongated in direction of rolling and showing high contrast in tarnish hues, the ones to grow first from less impure solid solutions having the lighter tones. Long heating at 450 to 600 deg. C. gives crystals less elongated and having but slight tarnish contrasts. Supplementary experiments on slightly worked 82:18 Al:Zn and α brass showed recrystallization in every case to start at grain boundaries, along twinning planes or in contact with a speck of insoluble impurities.

[1] *Trans.* Faraday Society, 1917, vol. 12, p. 62.
[2] MET. & CHEM. ENG., 1918, vol. 18, pp. 172, 523.

Current Events

in the Chemical and Metallurgical Industries

Stanley Patent Bill Being Pushed

Every effort is to be made to obtain the prompt enactment by Congress of Senator Stanley's bill amending the Revised Statutes relative to patents which will require manufacture within continental United States of any article covered by a patent granted a foreigner.

In recommending the legislation to the Senate, the Committee on Patents pointed out that the War Department noticed in April that a large number of applications of patents were being filed by Germans. Many of these have been assigned to various German companies, including that of Krupp at Essen. An investigation by the War Department of 228 of these applications which related to ordnance disclosed the fact that all were assigned to the Krupp company.

The Secretary of War approves the legislation in that it prevents foreigners from obtaining United States patents for the sole purpose of protecting them against American manufacture of the articles covered by such patents. Secretary Weeks points out that under the present law foreigners enjoy the same protection and monopoly as to patent rights as do American citizens. In cases where patented articles are fully protected by the United States patents, it is of little consequence how high an import duty is placed on articles manufactured under such patents in foreign countries, since they are not manufactured in the United States and are necessary to the carrying on of our industries and must be imported regardless of the high tariff.

Secretary Weeks believes that the Stanley bill insures the foreign holder of the patent a reasonable return on his invention and at the same time insures the United States a domestic source of the product.

Gas and Fuel Symposium Planned

The processing of fuels and the chemistry of gas making will receive special attention at a symposium which is planned as a part of the New York meeting of the American Chemical Society next October. Plans for this occasion are just being perfected through the Division of Industrial and Engineering Chemistry of the society. C. H. Stone of the Rochester Gas & Electric Corporation will be chairman and R. S. McBride, engineer-chemist, Colorado Building, Washington, secretary of this session. The committee to work with these officers is soon to be designated by the division so that comprehensive plans may be formulated during the summer. Chemists and engineers interested in the project or having suggestions regarding papers which should form a part of the program should communicate with the secretary of the symposium. It is thought that a gas and fuel section of the A.C.S. may be formed as an outgrowth of this work, so that more attention may be given to the chemistry of fuels processing than is possible through the engineering and commercial organizations which are active in this field.

Scholarship to France for Wisconsin Engineer

A scholarship in the Metallurgic and Mining Institute of the University of Nancy, France, has been recently established for a University of Wisconsin student of engineering. The donor is Mme. K. de Billy, who established the scholarship in memory of her late husband, Edouard de Billy, a mining engineer and formerly French high commissioner to the United States. The scholarship is for 4,000 francs and is open to any student who has completed three years of engineering work and can pass the requirements for the University of Nancy. Unless a Wisconsin student qualifies the scholarship goes to some other American university.

Industrial Alcohol Legislation

The Committee on Rules of the House of Representatives was prepared at the time of this writing to report out a rule assigning a definite time for the consideration of the Volstead bill, to which manufacturers of industrial alcohol have taken exception. The Committee on the Judiciary, which reported out the bill, has insisted strenuously on its prompt consideration. Some displeasure has been indicated because the Committee on Rules did not act more promptly.

It is understood that the rule under contemplation will not preclude the offering of amendments on the floor of the House. If the House should vote down amendments looking to the liberalization of the control over industrial alcohol, the possibility of alterations by the Senate still exists.

The new prohibition commissioner has been sounded out and is known to be keenly aware of the necessity of placing no unnecessary obstacles in the way of the manufacture and use of industrial alcohol for non-beverage purposes. This is regarded as a very hopeful feature of the situation, since any law that may be enacted will leave a great deal to the discretion of the prohibition commissioner.

Du Pont Dye Plant Increases Production

The American dye industry is slowly recovering from the recent depression. Operations in the large dye works of E. I. du Pont de Nemours & Co. at Deepwater Point, N. J., are back on a six-day-a-week basis. This change went into effect on June 13 and applies to all departments in the plant. At the same time the management reduced the wages of all employees from 7 to 15 per cent. Salaries were reduced about 15 per cent when the bonus was discontinued on Feb. 1. Some of the older and more experienced operators, who have been out of work for several months, are being re-employed.

In most departments production is confined to dyes that the company has not hitherto manufactured, as the stocks on hand of the older staples are sufficient to meet the demand. In several instances special efforts are being made to manufacture those dyes for which the War Trade Board has issued import licenses. Until these dyes are manufactured in this country, it can hardly be said that the dye manufacturers are meeting all the demands of the dye consumers.

TNT Not Highly Sensitive

That TNT is not highly sensitive and is perfectly safe for industrial uses is a statement contained in a formal announcement by the Bureau of Public Roads. The announcement was prompted by the recent explosion of a bomb attached to an airplane at the Aberdeen Proving Grounds. Many of the reports of that accident conveyed the impression that TNT is a very sensitive explosive. The bureau points out that it has been distributing TNT to the state highway departments in large quantities for more than a year to be used for blasting purposes in highway construction and that during that entire period not a single accident has occurred. The Bureau of Public Roads points out that the accident at Aberdeen gives splendid proof that TNT is not a highly sensitive explosive. There were four 300-lb. TNT bombs attached to the airplane when the propeller struck the 50-lb. bomb which exploded. These bombs were intended to explode by impact. The force of the blow from the propeller was sufficient to detonate the one bomb but the explosion did not detonate the four 300-lb. bombs.

The success attending the use of TNT in road construction has led the bureau to undertake the distribution of picric acid, which is available in large quantities, to be used for land clearing.

Atlas Powder Company to Produce Refining Carbon

Many attempts have been made in the past sixty years to produce an efficient substitute for bone-char used in the refining of numerous products such as sugar, glucose, maltose, lactose, vegetable oils, gelatine, glue, alcohol products and other chemicals and pharmaceuticals. While the need for such a refining carbon has been growing more and more urgent, these attempts have not been commercially successful. Now after several years of research and tests, the Atlas Powder Co., Wilmington, Del., has drawn plans for a 6,000-ton plant to manufacture "Darco," a decolorizing and refining carbon which will be put on the market at a price to compete successfully with all other refining materials.

The principal reasons necessitating a bone-char substitute have been the constantly increasing price of this carbon of animal origin, due to the growing demand and inadequate supply. Refining carbons have been imported, but these expensive carbons cannot be used on a large scale without revivifying many times. Revivification has so far not been an easy and cheap process because of the considerable loss due to the large percentage of volatile fines contained.

The advantages claimed for "Darco" are that it is twenty-five to thirty times as efficient as bone-char, is rapid in action, and that it is so cheap that it may be used two or three times and then be discarded without the need of revivifying. There are no royalty charges added to its cost.

Heretofore chemists have focused their attention on particular raw materials from which decolorizing carbons were to be made, such as cinchona bark, rice hulls, corncobs, hydrolized wood waste, kelp, etc. While some of these carbons looked promising in the laboratory stage, the low yield in final product from the raw material and the cost of carbonization and subsequent washing made commercial production prohibitive. On the other hand the idea has also been proved mistaken that any kind of carbonaceous waste material, such as, for instance, the molasses residue in the manufacture of alcohol or the waste liquor in the paper pulp industry, would produce commercially efficient decolorizing carbon. The theory that any finely divided carbon would make a good decolorizing agent has not worked out.

This new development is the first attempt in this country by a large and well-known chemical manufacturing concern, such as the Atlas Powder Co., to undertake the manufacture of a decolorizing carbon. Because of the importance of efficient decolorizing, deodorizing and refining carbons in a large number of chemical industries, this project is receiving wide interest.

Fixed Nitrogen Laboratory to Be Transferred

The Fixed Nitrogen Research Laboratory will be transferred on June 30 from the War Department to the Department of Agriculture. With the laboratory the War Department will transfer the remainder of its appropriation for this type of research. The amount is approximately $500,000.

The laboratory will be an independent unit of the Department of Agriculture and will be under the direction of Dr. Richard C. Tolman, who has been conducting it for the War Department. Dr. Tolman will report directly to the Secretary. He will have the assistance of an advisory committee to be made up of representatives of the agricultural bureaus having immediate interest in nitrogen matters.

Plans are being made so that the present appropriation will be sufficient to maintain the laboratory for two years.

Plastic Gypsum Commercially Available

Plastic gypsum made in accordance with the Bureau of Standards recommendations is now available commercially according to announcements. The principles on which this process were based were recently described in CHEMICAL & METALLURGICAL ENGINEERING[1] by Warren E. Emley, who discovered and has patented the improvements which make possible the preparation of calcined gypsum in a valuable plastic condition. Other companies are also reported to be building mills for the production of this product.

[1]CHEM. & MET. ENG., vol. 24, p. 740, April 27, 1921.

Federal Regulation of Fertilizer Opposed

Senator Fletcher, of Florida, has presented to the Senate a resolution by Southern Commissioners of Agriculture protesting against federal regulation of the "sale and shipment of fertilizer in interstate and foreign commerce, to prevent the adulteration and misbranding thereof."

The resolution recites that it was actuated by the introduction of a bill in Congress to that end. This assumption is in error, however, as no bill has been introduced at this session of Congress which attempts such regulation of the fertilizer traffic. The Bureau of Soils frequently is accused of harboring an earnest desire for such legislation. The charge has been made that it takes advantage of the requests of Congress for information as to the fertilizer situation to bring forward arguments which make good propaganda for such legislation. So far as can be ascertained, however, Congress is not entertaining at this time any serious intention of legislation looking to federal regulation of fertilizers. There is some difference of opinion as to the effect on the fertilizer industry of the control which is proposed to exercise over the packers.

Obtaining Copies of Scientific Articles

Many scientists lack the library facilities which their work demands. They are compelled either to journey to distant libraries or to try to borrow books by mail. Often it is difficult for them to locate something that is badly needed, and again it may be impossible to borrow it.

The Research Information Service of the National Research Council is prepared to assist investigators by locating scientific publications which are not generally or readily accessible. It will also, as is desired, have manuscripts, printed matter or illustrations copied by photostat or typewriter. The cost of copying varies from 10c. to 25c. per page. No charge is made for this service unless an advance estimate of cost has been submitted and approved by correspondent. Requests for assistance should be addressed to National Research Council, Information Service, 1701 Massachusetts Ave., Washington, D. C.

Chemical Exhibit a Success

Members of Congress are practically unanimous in commending the chemical exhibit which was displayed in the office building of the House of Representatives by the National Research Council. The exhibit now has been moved where it will be on permanent display. The National Research Council has prepared a copy which is available for exhibition at any point throughout the country where there may be a demand for it.

Representative Longworth declares that members of Congress obtained more information concerning the chemical industry in a half hour at the exhibit than they would have received if they had read volumes.

Stamford Chemical Society Visits Testing Plant

On the afternoon of June 11 a party of members of the Stamford Chemical Society visited the research laboratory and small testing plant of Joseph H. Wallace & Co., at Webb's Hill, on the outskirts of Stamford, Conn. Interesting talks were given by Mr. Wallace, Mr. Greenwood and their research chemist, Mr. Stevens, on all phases of their process for producing high-grade paper pulp material with turpentine, fine oil and rosin as byproducts from the stump-wood of the Southern pine.

The process involves steaming the properly-sized wood chips for recovery of the turpentine and pine oils, treatment of the steamed chips with a fraction of the pine oils that has been found to be a good solvent for extraction of the rosin, and a steam distillation of the extract to recover the rosin and solvent. The treated chips then have a uniform composition and are in an ideal condition for transfer from the field plant to the paper pulp mill and treatment there with the mixed caustic soda and sodium sulphide solutions according to the regular routine of the sulphate process which is recommended by J. H. Wallace & Co.

A strong, high-grade paper can be uniformly produced by this method.

New Chemical and Oil Companies

During the month of May twenty-four companies with capitalization of $50,000 or more were organized to manufacture chemicals, drugs, dyes and affiliated products. The total authorized capital of such corporations amounts to $12,400,000, as compared with an indicated investment of $9,390,000 for companies formed in this line in April. A year ago, May, 1920, the amount of capital involved in new companies in the chemical field totaled only $3,392,500. During May, 1921, only two of the companies chartered had an authorized capital of $1,000,000 or larger. For the first five months of the present year a total of $62,300,000 in capitalization is shown in new companies formed to manufacture chemicals and affiliated products.

During the same month of May, 102 companies with a capital of $50,000 or larger were organized to operate in different branches of the petroleum industry. The total capitalization is $112,925,000, or the smallest aggregate for any month of the present year. During the preceding month, April, 110 companies were formed, with total authorized capital of $227,470,000, while in May of a year ago 160 such concerns were organized, with an aggregate capitalization of $200,350,000. Five companies were formed during May, 1921, with an authorized capital of $10,000,000 or larger.

Ruling Scale by Light Waves

It is interesting to note that it is now possible to construct scales for the measurement of length directly from the fundamental wave lengths of light without the use of any intermediary standard. As an example of work of this sort which is now being regularly carried out, it may be mentioned that the Bureau of Standards recently completed the rulings on a 6-in. scale using light waves from a tube containing neon (wave length 5800 to 6600 A) as the length standard. The work was done for the Brown & Sharpe Manufacturing Co.

Potash Outlook for 1921

Potash stocks in the United States are estimated by the Potash Producers Association to have been 50,000 tons K_2O on April 1. The 1920 consumption of fertilizer is given as 7,500,000 tons, a record for the industry. Figuring 3 per cent as the average potash content of 1920 fertilizer, 225,000 tons of K_2O was used. With lower fertilizer prices likely to prevail this fall and with the farms of the country still under-fertilized as a result of war shortages, a much larger consumption of potash in 1921 is predicted.

Would Modify Pulp-Wood Restrictions

All probabilities favor the ultimate passage of the Senate resolution providing for the naming of a commission to confer with the Canadian authorities in the hope of obtaining modifications of the Canadian restrictions on the export of pulp wood to the United States. These restrictive orders were made after the American mills had acquired pulp-wood holdings and rights in Canada.

Exposition at Portland, Ore.

Another step has been taken by way of preparation for the International Exposition to be held in Portland, Ore., in 1925. The Senate has passed a bill authorizing the President to invite foreign countries to participate in the exposition. The exposition is intended to celebrate the completion of the transcontinental and Pacific highways, the centennial of the invention of the electromagnet and to exemplify the development of hydro-electric energy.

Aluminum Solders

All tests on recent aluminum solders have been completed by the Bureau of Standards and circular 78, "Solders for Aluminum," will now be revised to include these tests. In spite of claims made by those interested, no solder for aluminum has yet been found which will withstand the corrosion test, although the fused zinc chloride solders withstand corrosion for the greatest length of time.

Patent Office Bill to Be Reported Out

Representative Lampert's bill providing for increased salaries in the Patent Office is to be reported out in the near future. It is known that there is no opposition to the measure in the committee. Prompt action by the House is expected. This bill failed at the last session because of the insistence on the part of Senator Norris, then the chairman of the Senate Committee on Patents, that the Senate decline to recede from its amendment which authorized the Federal Trade Commission to administer patents for Government employees.

Georgia Kaolins to Be Studied

The Georgia kaolins are to be the subject of a special study to be undertaken by the Bureau of Mines under a co-operative agreement with the Central of Georgia R.R. These white clays of Georgia have been used with some success in ceramic industries, and it is believed that means can be found for a very much more extensive use of them if economical methods can be found of ridding them of impurities.

Administration of War Minerals Relief Act

In all probability the administration of the war minerals relief act will be lodged in the future in a single individual. It is understood that Secretary Fall has tendered this position to Ira E. Robinson, of Grafton, W. Va. It is Secretary Fall's desire to wind up the settlement of all war minerals claims at the earliest possible moment. Since most of the work in this connection has been done, he believes that it will be unnecessary to continue the commission form of administration.

Reclaiming of Foundry Sands

A co-operative study of the problems encountered in the reclaiming of foundry sands is to be made by the Bureau of Mines and the American Foundrymen's Association.

Mme. Curie Given 50 Milligrams of Mesothorium

During the recent visit of Mme. Curie in Philadelphia she was presented with 50 milligrams of mesothorium by the Welsbach Company.

Book Reviews

A METALLOGRAPHIC STUDY ON TUNGSTEN STEELS, by *Axel Hultgren*. John Wiley & Sons, Inc., New York, 1920. Pp. 95; illustrated. Price, $3.

This book is unusual in character in that it covers work which is ordinarily presented at meetings of technical societies or in technical journals. It describes the results of investigation of the transformations and structures of a number of tungsten steels under varying heat-treatments. There is, in addition, an appendix which comprises a critical review of the investigation of tungsten steels by Honda and Murakami,[1] but it is to be regretted that the original text was not rewritten following the author's first knowledge of these Japanese investigations.

The solubility of tungsten in austenite was found to be limited to certain tungsten proportions which decreased as the carbon content increased. Beyond this limiting composition there appeared a special constituent which, in the case of alloys carrying carbon corresponding to cast iron, was cementite; in high-carbon steels of over 0.7 per cent carbon, WC, but a metastable double carbide Z_3 appeared if stable conditions were not reached; in steels containing less than 0.7 per cent carbon, a double carbide designated Z_1; in low-carbon alloys, an iron tungstide.

It was found that Ar_1 in these alloys was raised approximately 10 deg. C. for each per cent tungsten and that the

[1] This work was reviewed in CHEM. & MET. ENG., April 27, 1921, pp. 745-748.

eutectoid composition of the austenite was displaced toward lower carbon contents by about 0.05 per cent for each per cent tungsten. The pearlite transformation was retarded and this mechanical mixture was observed to be finer than that in carbon steels.

The lowering of the pearlite transformation on cooling from high temperatures (stabilization of the austenite) was marked and with certain combinations of composition, initial temperature and rate of cooling this change is entirely suppressed. So-called secondary ferrite was precipitated from the stabilized austenite at relatively low temperatures (providing the rate of cooling was not too slow) at temperatures of the low critical range found by earlier investigators.

A number of other conclusions are drawn and the relation of free carbides to magnetic properties of tungsten magnet steels is discussed and there is given a tentative Fe-W-C equilibrium diagram.

Presenting, as it does, the views of an investigator who has spent much time in the study of carbides in steels, the text should be of interest to anyone interested in the theory of a variety of commercial steels in which tungsten is an essential component. H. J. FRENCH.

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A FRENCH-ENGLISH DICTIONARY FOR CHEMISTS. By *Austin M. Patterson*, Ph.D. 384 pp., New York: John Wiley & Sons, Inc. Price $3.

Chemists who have had occasion to use Dr. Patterson's "German-English Dictionary for Chemists" will welcome the arrival of this sister volume. The earlier book has proved itself an able assistant to the many readers, old and young, of scientific chemical German. The new volume, following the same general plan, promises to prove just as valuable to those who delve into *Comptes-rendus* or *Annales de Chimie*. French chemical literature, to be sure, covers a considerably smaller field than the German and to the beginner, at least, its translations offer fewer difficulties. There are, however, as the author points out, many obstacles such as idiomatic constructions and irregular verbs which can, at times, prove most troublesome. For the novice's benefit the introduction of the book contains many notes on chemical nomenclature and word derivations which should prove helpful in the use of the vocabulary. Our eccentric friends, French verbs, are appropriately introduced in a brief statement by Prof. Frank Vogel, of the Massachusetts Institute of Technology. The new dictionary is of convenient size and shape and its flexible green binding makes it easy to distinguish it from its German companion.

SIDNEY D. KIRKPATRICK.

Personal

CHESTER M. CLARK, formerly head of the corporation department of the constructing engineering firm of Stone & Webster, Boston, has recently been chosen treasurer of Arthur D. Little, Inc., Charles River Road, Cambridge, Mass.

Dr. C. E. CURRAN, formerly with the Mead Development & Engineering Co., Dayton, Ohio, is now at the Forest Products Laboratory.

J. R. DAVIES, for the past seven years in charge of the laboratories of the Calumet Baking Powder Co., Chicago, has been appointed assistant plant manager and chemical manager of the chemical works of the Calumet Baking Powder Co., Joliet, Ill.

Dr. G. J. FINK, formerly with the Hooker Electrochemical Co., Niagara Falls, is now associated with Dr. M. E. Holmes in the chemical department of the National Lime Association at Washington, D. C.

Captain WALTER GRAHAM has resigned from Government service at Washington, after making investigations of raw materials and blast furnace and steel works practice for the Fuel Administration, Army Ordnance Department, Bureau of Standards and the U. S. Tariff Commission, and has moved to New York to engage in examination and reports on coal, iron and steel properties and operations. Captain Graham's present address is care of the Harvard Club, New York.

ROY A. HAYNES has been appointed the new federal prohibition commissioner to succeed John F. Kramer.

Dr. MAX HENIUS of the Wahl-Henius Institute, Chicago, Ill., has left for a visit to Denmark and northern Europe.

RICHARD LEWIS LLOYD, of the Dwight & Lloyd Sintering Co., Inc., was honored at the recent commencement of Washington University, St. Louis, with the degree of Master of Science. In conferring the degree Chancellor Hall referred to Mr. Lloyd as "A distinguished metallurgist, product of training in mining and metallurgy at this university in the early '90s; associated with important metallurgical processes; identified with many movements in smelting, especially copper smelting, where he had been instrumental in perfecting new methods in North and South America and in European countries; sharer in developing the well-known Dwight & Lloyd sintering apparatus; author of technical papers for engineering and mining journals and for technical societies."

RICHARD R. REES has resigned as metallurgist of the Neptune Meter Co. to accept a similar position with Neemes Bros., Inc., of Troy, N. Y.

Dr. RALPH E. RINDFUSZ, assistant to the president of the American Writing Paper Co., has been elected secretary of the company to succeed Michael N. Slotnick, resigned. In addition to his new duties as secretary, Dr. Rindfusz will continue as assistant to the president and will also retain general supervision of the department of chemical research, which will remain under the direct capable management of Dr. L. E. Roberts.

IRA E. ROBINSON, of Grafton, W. Va., has accepted the appointment to be war minerals relief commissioner. He already has entered upon his duties and is making a thorough review of the status of war minerals relief. Horace G. Pomeroy, a member of the commission under the preceding administration, has consented to remain in the service that he may be of any possible help to Mr. Robinson in acquainting him with the status of various matters pertaining to the commission's affairs. His resignation, however, will become effective June 30.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, June 20, 1921.

The past week has witnessed a slowing down of the recent increased activity in heavy chemicals. The more important items have been subject to irregular periods and the movement has reflected the cross-currents which characterize the consuming trade. The market fundamentally is very much brighter, as stocks in resale quarters have diminished without any corresponding increase in production. There were instances uncovered where spot stocks were actually scarce and advances have occurred where buying orders were executed. In most cases, however, buyers experienced some difficulty in obtaining supplies at apparently attractive prices. Various chemicals that have come under the license system have advanced and the general belief that others may be placed under that classification has prevented short selling and has tended to steady prices. Consumers still prefer to adhere to the conservative policy which has been so effective for the past year and most of the transactions have been limited to small lots. Trading of this caliber does not help conditions any too much and indicates that consumers are not reconciled to the idea that the market has touched bottom.

The decline in exchange rates has put a damper on any hopes of an early revival in export trade. The exchange has been keenly watched by leading chemical interests and

its peculiar action has caused considerable comment. There are many opinions expressed in chemical circles, but none seems really to understand the fundamental reason for the decline. Undoubtedly one of the principal factors is the position of speculators in foreign exchange. In January, 1921, sterling sold down to $3.35 and then had a steady advance to $4 in April. During this period a great amount of speculative buying of foreign moneys occurred in expectation of an early settlement of the German indemnity question. Now these speculative purchases are probably being liquidated. It is said that German bankers established over $300,000,000 of credits in various countries when marks rose to a high level with the prospects that these credits could be used in the indemnity settlement that would eventually come. Now it is reported that Germans are transferring these credits into dollars and as a result are selling all exchanges. Still another important factor in the demoralization of sterling is the drawing down of foreign balances by American banks. There is a great deal of confusion in the foreign exchange market, but no apparent uneasiness and no evidence of any alarm.

Imports

Imported soda ash has not been in as much demand as heretofore. Buyers have gradually eased up purchasing this commodity through fear of delayed shipments resulting from the general abnormal conditions in England. Some material was known to have been sold for July shipment, but under present conditions sellers are not pushing any new business. The placing of oxalic acid in the "synthetic organic chemical" list requiring a license for import has steadied that commodity and prices have been well sustained around the point recently established at the late advance. Odd lots of this material arriving rather late are held in bond and are a cause of great concern to holders. There were rumors current in trade circles that prussiate of soda was being placed on this license list and this had a steadying effect on values. There is enough caustic potash in dealers' hands both of domestic and foreign manufacture to keep prices rather irregular. Quinine, camphor and menthol have been quite firm of late and more confidence is expressed regarding prices. There have been no new reports of any imports of chlorate of soda and prices have ruled firm. Imported tartaric acid has shown its weak spots on account of lack of buying support.

Domestic Inquiry Increases

The domestic inquiry has shown a slight increase over the preceding week without resulting in any appreciable expansion in business. Basic prices on soda ash and caustic soda are lower, while the resale markets on both materials are stronger, with higher prices named generally on caustic. It is stated that producers have been placing more business recently. Small-lot trading in bichromate of soda has increased, with prices favoring sellers. Nitrite of soda seems to be in a more favorable position for an advance than at any other time this year. The greater portion of supplies is in hands that are not inclined to liquidate. It seems reasonable to assume that after carrying stocks for several months and now protected from foreign competition, buyers will pay higher prices when they attempt to replenish stocks. Business in general throughout the spring has been rather spotty and so far business during June has not been as good as in previous months. The probability is that the slowness is temporary and within a few weeks will have vanished. Manufacturers and dealers are looking forward beyond the immediate present and expect fall business to be active.

Chemicals

Resale lots of 76 per cent *caustic soda* of standard brand sold at $4.15 per 100 lb. ex-warehouse N. Y. and it is doubtful if more than odd lots could be purchased below this figure. Outside makes were quoted at 4c. per lb. The export price for standard resale material is given at 4¼c. per lb. Actual business was quiet, but offerings were rather limited and had a tendency to hold the market steady. Producers quoted contracts at 3¼c. per lb., basis 60 per cent f.o.b. works, and 5c. per 100 lb. higher for single cars. Higher prices were quoted for imported *prussiate of soda* on spot, and sales were recorded at 12½c. per lb. The former price of 12½c. was refused on firm bids in several directions. The demand for small lots was quite active and there are rather persistent rumors that this chemical will eventually be placed by the Treasury Department under the classification requiring license to import. Some sellers refuse to shade 2½c. per lb. on less than carlots for light *soda ash* in single bags ex-store. It is stated that cars could be purchased at $2.15@$2.20 per 100 lb., although the market looked decidedly firm under a continuance of light supplies. Resale lots in barrels are quoted at $2.50@$2.75 per 100 lb. according to quantity. Inquiries for home and export were quite numerous, with buyers always a trifle below sellers' views. Producers of *copper sulphate* have advanced their prices on a stronger copper market and are now quoting small crystals on a basis of $5.62 per 100 lb. in carlots and large crystals at $5.75 per 100 lb. Imported *citric acid* is quoted at 46c. per lb. spot, duty paid, with intimations that this price might be shaded on a firm offer for a round lot. The tendency of the market, however, has been firmer of late and it is asserted that holdings have been reduced through recent quiet buying. The general range was 46@47c. per lb.

Prominent sellers of *copperas* report a fair inquiry, with actual business rather spotty. Sales have been made at $19@$21 per ton, depending entirely upon grade, quantity and seller. Producers of *niter cake* are offering this chemical on a basis of $5 per ton in bulk at the works. The call of late has been quiet and it is understood that a moderate accumulation of supplies exists. Sales of *oxalic acid* during the week were reported at 19@19½c. per lb., with some sellers quoting up to 20c. per lb. for prime material ex-warehouse. The tone of the market remains quite firm and many are convinced that any permanent buying movement would be readily reflected in the course of values. Producers of *sulphuric acid* state that contracts for the 66 deg. are being placed at prices ranging from $18@$20 per ton in tank cars f.o.b. works, the inside figure being named for large quantities. It is also stated that sales of the 60 deg. have been made down to $11 per ton, although sellers as a rule are not eager to quote under $11.50 for tank cars at the works. Sales of *oleum* are reported at $21@$23 per ton in tank cars. A good miscellaneous call for industrial purposes is reported, although new business has not shown any added activity since the turn of the month. Stocks of *muriate of potash* are quite heavy and holders are pretty well tired. Quotations are around $50 per ton, but buyers have experienced no difficulty in finding lots at $49 or even less. German *caustic potash* in the spot market is offered lower around 5@5½c. per lb., with shipment material offered at even lower figures. The demand is very slow and holders are willing to shade for sales. Shipment from Germany can probably be had as low as 4½c. per lb. Resale American material is pretty well cleared out of the market.

Quotations on the spot market for *fluoride of soda* are around 11½@13½c. per lb., according to seller and quantity. A marked increase in the purchases of Japanese refined *camphor* has been noted in the market during the week. Sales went through at 67, 68 and 70c. per lb. and the market then moved to 72c. for slabs in cases. Some sellers are bullish in their ideas and are quoting 74@75c. per lb. Small packings are held at 82@85c. per lb. Spot stocks are reported to be materially reduced. American refiners still adhere to the 80c. basis for bulk camphor in barrels. *Bromides* are in fair routine request. Prices are easy at 16@18c. per lb. for imported *potassium bromide*. *Sodium bromide* is held at 21c. per lb. with a greater interest from some consumers reported. American makers are holding potassium bromide at 24c. and sodium at 25c. per lb.

Coal-Tar Products

The better tone in the coal-tar products market has kept up pretty well throughout the past week and is largely due to the gradual improvement in operations in textile mills, for reports in general have shown a better demand from actual consumers in domestic quarters, while from foreign

directions the demand shows a marked increase. Many of the more prominent sellers talk in a more cheerful tone and while shading is still posssible in some quarters on firm business, prices all around are more firmly held. Business in dyes has been slowly improving and as a consequence intermediates are generally firmer. Producers of intermediates say there is a much wider call and some of the lesser active issues are also starting up and prices are noticeably stronger. Several comparatively strong resellers have shown an inclination to take up the weakest of the spot offerings in many items, especially *beta naphthol*. Prices throughout the market are firmer on this account coupled with the improved feeling among consumers. The situation in *benzene* has shown no change, but consumers are showing less interest. Makers' prices are unchanged at 27@33c. per gal. in tank cars and less, although they are able to offer only a little at these figures. Resellers have limited quantities to offer on the open market. The 90 per cent grade is quoted unchanged at 25@28c. per gal. The resale market in *naphthalene* was very quiet, with stocks still offered below 8c. per lb. Makers' prices are still unchanged. Most producers of H acid are quoting $1.25 per lb., although offers from one source are heard lower at $1.20 per lb. Buyers have virtually no interest and it is probable that as low as $1.10 could be done with a firm order in hand. Technical *salicylic acid* is still in a weak position. Offers are heard around 19c. per lb., although some makers are quoting up as high as 22c. per lb. In the resale market offers of the U.S.P. are heard as low as 20c. per lb. Recent offers of *aniline oil* from resellers have been withdrawn to a great extent from the market and efforts to locate resale stocks were unsuccessful during the week. Makers are keenly competing for such business as comes into the market and price cutting is quite general. Quotations are given at 20@27c. per lb., according to maker, but it is known that no maker would turn down any real business at the 20c. level. The market on *beta naphthol* is quite firm at 38@40c. per lb., according to seller. Weak resale lots are being taken up by stronger holders and any business that has come into the resale market from consumers has met a firm price of 38c. per lb. Manufacturers' prices are quoted at 40@42c., but it is possible that they will meet the resale market at its present level.

Waxes

Trading in the market for *beeswax* was along routine lines, but with stocks practically light no selling pressure was in evidence and prices rule steady. African crude held at 16½@17c. per lb. Brazilian crude was offered at 24@26c. per lb., according to color, quantity and holder. Imports of beeswax in April were officially placed at 82,871 lb., which compares with 957,816 lb. for April a year ago. Imports for the ten months ended with April amounted to 1,909,735 lb., as against 3,205,102 lb. for the corresponding period a year ago. An unsettlement in shipment prices featured the market in *carnauba wax* and with supplies on hand more plentiful and the demand rather slow consumers showed no apprehension over the near future. No. 2 North Country was lowered on spot to 25c. per lb. Freer offerings of spot *Japan wax* sent prices to somewhat lower levels, and at the close the market stood at 17@17½c. per lb., round lot basis. Primary markets showed no important changes in the last week according to importers. The demand in general is quiet. Offerings of *montan wax* were noted at 6½@6¾c. per lb., the situation being easier on increased holdings. On forward business it was possible to do 5¾c. per lb. The decline in the export demand for *paraffine wax* is the principal cause in the unsettlement of prices. The domestic inquiry also remained subnormal and selling pressure has resulted in quite some price slashing, especially where round lots have been involved. According to official figures the exports of paraffine refined and crude for the month of April amounted to 9,939,611 lb., which compares with 35,874,485 lb. for April a year ago. Crude wax was offered at 2½@2¾c. per lb., according to melting point. Refined held nominally at 3¼c. per lb. for the 118-120 deg. melting point. There were sellers of the 130-132 deg. at 4¾c. immediate shipment, carlot basis.

The Chicago Market

CHICAGO, June 16, 1921.

Quieter conditions prevailed in the industrial chemical market during the past week and no large transactions were reported. Prices as a rule were quite firm with a few advances noted. Buyers are still averse to anticipating and what material that is moving is in small quantities for immediate consumption.

General Chemicals

Caustic soda is firm with spot supplies light. The solid 76 per cent is offered at 4c. and the ground at 4½@4¾c. per lb. delivered. *Soda ash* is very firm and holders show no disposition to shade the present price of $2.60 per 100 lb. for barrels. *Aluminum sulphate* is in small demand and supplies are available at 2¼c. per lb. for ordinary lots. *Sal ammoniac* is firm and 8½c. per lb. was the best offer noted, while some factors are holding their supplies for 9c. *Barium chloride* is very quiet and ample supplies are available at $75@$85 per ton, according to the quantity. There is a fair demand for U.S.P. *epsom salts* and the price is unchanged at 3¼c. per lb. for barrels. *Formaldehyde* is dull and unchanged at 14½c. per lb. in barrels.

The *alcohol* market is extremely quiet, although as a rule prices are maintained. Denatured No. 6, 188 proof, is quoted by first hands at 33c. per gal. in five-drum lots and nonbeverage 190 proof at $4.85. Methyl alcohol is in limited request and holders are asking 80c. per gal. for the 95 per cent in drums.

Caustic potash is very unsettled and supplies of the 88-92 per cent are available at 7c. per lb. for single drums. This price could probably be shaded considerably with large business. *Potassium bichromate* is a little lower and small quantities are offered at 14½c. per lb. delivered. In contrast, *soda bichromate* is firmer and most holders have advanced their ideas to 9½c. for single casks. *Nitrite of soda* is very firm and 9c. per lb. was the lowest offer noted. There is a fair movement of *sodium bicarbonate* and prices are maintained at 2¾c. for barrels. *Glycerine* is in very poor demand and prices are easy with 15¾c. per lb. the lowest offer noted.

The list of acids is firm and quiet. The action of the War Trade Board strengthened the *oxalic acid* market and holders are now asking 20@21c. per lb. for first class goods. *Glacial acetic acid* is very quiet and the price is unchanged at 11@11½c. per lb., according to the quantity. Keener competition has forced the price on the 28 per cent material lower and supplies are available at 2½@2¾c. per lb. in barrels. The heavy acids are quiet with prices unchanged. Manufacturers quote 66 deg. *sulphuric* at $19@$20 per ton in tank cars f.o.b. works.

Vegetable Oils

This branch of the trade is very quiet, with little or no movement of stocks reported. *Linseed oil* is lower, with less than car lots held at 82c. per gal. for the boiled and 80c. for the raw.

Naval Stores

The leading factors describe this market as very slow with inquiries light. *Turpentine* is lower, with supplies available at 59c. per gal. in five-drum lots. There is practically no movement of *rosins* and the prices are unsteady. The WG is quoted at $7.75 per 280 lb. for carload lots and $8.75 for smaller quantities. *Rosin oil* is also quiet and easy at 60c. per gal. for single barrels.

The Iron and Steel Market

PITTSBURGH, June 17, 1921.

Each week the steel market shows that it is possible for it to become still duller. Since the slight increment in buying and in specifying against contracts that occurred in April there has been a progression downward in activity, and as July, proverbially the dullest month of the year in the steel market, is now close at hand, no revival in the very near future is expected.

The best guess as to the rate of steel ingot production

this week by the steel industry as a whole is that it is at about 23 per cent of actual capacity, with a probable error of one or two points either way, this comparing with rates slightly above 30 per cent in April and May. The present flow of orders and specifications is not sufficient to support such a production rate, so that further decreases are to be expected.

Mill costs are of course extremely high, on account of the very low operating rates. Many small plants have been closed for months, it being impossible to operate at all on the occasional orders that could be picked up. Larger mills make steel continuously at very low rates, or close steel-making departments entirely one or two weeks out of every three, finishing departments being operated as occasion requires. There will probably be some complete stoppages July 1, this being an old practice that became uncommon in recent years.

There is no prospect of steel demand increasing in the next few weeks, unless all precedents as to July being an exceptionally dull month are broken. The trade looks to the more distant future and in not a few quarters there are predictions that there will be a revival of some proportions in August. In other quarters it is doubted whether there will be any material improvement before October. Farmers are expected to become freer buyers after they have realized on their crops. The extreme inactivity of the railroads in the matter of making repairs and of buying all sorts of supplies is noteworthy and in some quarters there is a conviction that the railroads are carrying the policy too far for their own good.

Steel Prices

In the majority of steel products what are known as "April prices" continue to rule as the general market. One exception is wire products, which, as noted a week ago are down $5 a ton. The market is altogether too dull to develop actual market prices, as there is scarcely any incentive to cut prices. It is the general belief that steel prices will be lower before there is anything like extensive buying, and the mills will hardly be averse to making reductions if more business can be obtained by such means.

The opinion apparently held by a majority of buyers, that there will be a general market decline by about Aug. 1, may, however, not be borne out. As to the extent of the decline, when a definite decline does occur, it is likely to be between $5 and $10 a ton. It would be idle to expect mills to reduce prices to the lowest level they may be able to reach in future, as they cannot get costs down as much as they can in a period of real activity. Using a weighted average of the prominent steel products, the April prices are about $17 per net ton under the war control prices. Disregarding the advances made by independents in 1920, these advances coming off by the end of the year, there have been three general declines, in December, 1918, March, 1919, and April, 1921, not far from $6 a ton each. A fair guess seems to be that the next decline will be as much or a little more. It must be remembered that there is such a gap between demand and productive capacity that the familiar course of the steel market can hardly be expected to be repeated, that course being for prices to decline to a low level, the mills to fill up and fall behind in deliveries and prices then to begin advancing.

Pig Iron and Coke

Pig iron continues to show a declining tendency, but the yielding of prices is now very gradual, this being one of the indications that the market is beginning to scrape bottom. Basic iron is quotable at $21 valley, against $21.50 a week ago. Foundry remains at $22.50 and bessemer at $23.

Two contracts for Connellsville coke have been made in the past week, each for six or seven carloads a day, or 7,000 or 8,000 tons a month. One contract was with the Empire Steel & Iron Co., Catasauqua, Pa., for July, August and September at $3 per net ton at ovens, the other being with the Colonial Iron Co., Riddlesburg, Pa., July to November inclusive, at $3.15. The lowest contract price previously was $3.25 or higher, several weeks ago, but for two or three weeks past the trade has understood that $3 could be done on a short-term contract. Spot furnace coke has declined from $3.25 to $3.10 or $3.15.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	–	$0.40 – $0.45
Acetone	lb.	$0.12½ – $0.12¾	.13 – .13½
Acid, acetic, 28 per cent	100 lbs.	2.50 – 2.75	3.00 – 3.25
Acetic, 56 per cent	100 lbs.	4.00 – 4.25	4.50 – 5.50
Acetic, glacial, 99½ per cent, carboys	100 lbs.	9.75 – 10.00	10.25 – 10.50
Boric, crystals	lb.	.13½ – .14	.14½ – .15
Boric, powder	lb.	.15 – .15½	.16 – .16½
Citric	lb.	–	.46 – .47
Hydrochloric	100 lb.	1.50 – 1.65	1.75 – 2.00
Hydrofluoric, 52 per cent	lb.	.12½ – .12¾	.12¾ – .13
Lactic, 44 per cent tech	lb.	.10 – .11	.11½ – .12
Lactic, 22 per cent tech	lb.	.04½ – .05½	.06 – .07
Molybdic, C. P	lb.	4.00 – 4.50	4.50 – 5.00
Muriatic, 20 deg. (see hydrochloric)		–	–
Nitric, 40 deg	lb.	.06½ – .06¾	.07 – .07½
Nitric, 42 deg	lb.	.07¼ – .07¾	.07½ – .08½
Oxalic, crysta's	lb.	.19 – .19¼	.19½ – .21
Phosphoric, 50 per cent solution	lb.	.13½ – .14	.14½ – .18
Picric	lb.	.20 – .25	.27 – .35
Pyrogallic, resublimed	lb.	–	1.90 – 2.15
Sulphuric, 60 deg., tank cars	ton	–	11.50 – 13.00
Sulphuric, 60 deg., drums	ton	–	13.00 – 15.00
Sulphuric, 66 deg., tank cars	ton	18.00 – 20.00	–
Sulphuric, 66 deg., drums	ton	22.00 – 22.50	23.00 – 23.50
Sulphuric, 66 deg., carboys	ton	–	–
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	22.00 – 23.00	–
Sulphuric, fuming, 20 per cent (oleum) drums	ton	25.00 – 26.00	26.50 – 27.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P	lb.	–	.90 – 1.00
Tannic (tech.)	lb.	.50 – .52	.54 – .57
Tartaric, crystals	lb.	–	.29 – .30
Tungstic, per lb. of WO	lb.	–	1.30 – 1.40
Alcohol, Ethyl	gal.	–	4.80 – 5.00
Alcohol, Methyl (see methanol)		–	–
Alcohol, denatured, 188 proof	gal.	–	.31 – .36
Alcohol, denatured, 190 proof	gal.	–	.38 – .42
Alum, ammonia lump	lb.	.03½ – .03¾	.04 – .04½
Alum, potash lump	lb.	.03¾ – .04	.04½ – .04¾
Alum, chrome lump	lb.	.13 – .13½	.14 – .14½
Aluminum sulphate, commercial	lb.	.01½ – .02	.02½ – .02¾
Aluminum sulphate, iron free	lb.	.03 – .03½	.03½ – .04
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07½ – .07¾	.08 – .08½
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .32	.33 – .35
Ammonium carbonate, powder	lb.	.08 – .08½	.09 – .10
Ammonium chloride, granular (white salammoniac)	lb.	.06½ – .06¾	.07 – .07½
Ammonium chloride, granular (gray salammoniac)	lb.	.07½ – .08	.08½ – .08¾
Ammonium nitrate	lb.	.07½ – .07¾	.08 – .08½
Ammonium sulphate	100 lb.	2.50 – 2.75	2.80 – 2.90
Amylacetate	gal.	–	4.00 – 4.25
Amylacetate tech	gal.	–	2.50 – 3.00
Arsenic oxide, (white arsenic) powdered	lb.	.06½ – .07	.07½ – .08
Arsenic, sulphide, powdered (red arsenic)	lb.	.11 – .11½	.12 – .13
Barium chloride	ton	59.00 – 59.50	60.00 – 62.00
Barium dioxide (peroxide)	lb.	.19 – .20	.21 – .22
Barium nitrate	lb.	.08½ – .09	.09½ – .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04½ – .05	.05½ – .06
Bleaching powder (see calc. hypochlorite)		–	–
Blue vitriol (see copper sulphate)		–	–
Borax (see sodium borate)		–	–
Brimstone (see sulphur, roll)		–	–
Bromine	lb.	.41 – .42	.43 – .45
Calcium acetate	100 lbs.	2.00 – 2.05	–
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	24.00 – 25.00	26.00 – 27.00
Calcium chloride, granulated	lb.	.01½ – .02	.02½ – .02½
Calcium hypochlorite (bleach'g powder)	100 lb.	2.15 – 2.25	2.35 – 2.50
Calcium peroxide	lb.	–	1.40 – 1.50
Calcium phosphate, tribasic	lb.	–	.15 – .16
Camphor	lb.	–	.73 – .75
Carbon bisulphide	lb.	.06½ – .07	.07½ – .08
Carbon tetrachloride, drums	lb.	.10½ – .10¾	.11 – .12
Carbonyl chloride (phosgene)	lb.	–	.75 – 1.00
Caustic potash (see potassium hydroxide)		–	–
Caustic soda (see sodium hydroxide)		–	–
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.08 – .09	.09 – .10
Chloroform	lb.	–	.42 – .44
Cobalt oxide	lb.	–	3.00 – 3.10
Copperas (see iron sulphate)		–	–
Copper carbonate, green precipitate	lb.	.20 – .21	.22 – .23
Copper cyanide	lb.	–	.50 – .62
Copper sulphate, crystals	lb.	.05¾ – .06	.06¼ – .06¾
Cream of tartar (see potassium bitartrate)		–	–
Epsom salt (see magnesium sulphate)		–	–
Ethyl Acetate Com. 85%	gal.	–	.85 – 1.00
Ethyl Acetate pure (acetic ether 98% to 100%)	lb.	–	.50 – .52
Formaldehyde, 40 per cent	lb.	.13½ – .14	.14½ – .15
Fusel oil, ref	gal.	–	3.00 – 3.25
Fusel oil, crude	gal.	–	1.75 – 2.00
Glauber's salt (see sodium sulphate)		–	–
Glycerine, C. P. drums extra	lb.	–	.16 – .16½
Iodine, resublimed	lb.	–	3.65 – 3.75
Iron oxide, red	lb.	–	.10 – .20
Iron sulphate (copperas)	ton	19.00 – 20.00	21.00 – 22.00
Lead acetate	lb.	–	.11½ – 13½
Lead arsenate, paste	lb.	.09 – .09½	.10 – .11
Lead nitrate	lb.	–	.15 – .20
Litharge	lb.	.08½ – .08½	.08½ – .09
Lithium carbonate	lb.	–	1.30 – 1.40
Magnesium carbonate, technical	lb.	.09 – .09½	.10 – .11
Magnesium sulphate, U. S. P	100 lb.	2.25 – 2.60	–
Magnesium sulphate, technical	100 lb.	–	1.10 – 2.25
Methanol, 95%	gal.	–	.75 – .77
Methanol, 97%	gal.	–	.78 – .82
Nickel salt, double	lb.	–	.14 – .14½
Nickel salt, single	lb.	–	.15 – .15½
Phosgene (see carbonyl chloride)		–	–
Phosphorus, red	lb.	.45 – .46	.47 – .50
Phosphorus, yellow	lb.	–	.35 – .37
Potassium bichromate	lb.	.11½ – .12	.12½ – .12½

		Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb.	$ .. – $	$0 30 –$0 31
Potassium bromide, granular	lb.	.... –	16 – 25
Potassium carbonate, U. S. P.	lb.	35 – 40	45 – 50
Potassium carbonate, 80–85%	lb.	06 – 06	06½– 07½
Potassium chlorate, crystals	lb.	08½– 10	10½– 14
Porassium cyanide	lb.	.... –	26 – 28
Potassium hydroxide (caustic p tash)	lb.	05 – 05½	05¼– 08
Potassium muriate, 80% K.C.l	ton	49.00 – 50.00	.... – ....
Potassium iodide	lb.	.... –	2 75 – 3 00
Potassium nitrate	lb.	09¼– 09½	10 – 12¼
Potassium permanganate	lb.	31 – 32	33 – 34
Potassium prussiate, red	lb.	35 – 37	38 – 40
Potassium prussiate, yellow	lb.	24½– 25	25½– 26
Potassium sulphate (powdered)	per unit	.... –	1 50 – 1 75
Rochelle salts (see sodium p tas tartrate)		.... –	.... – ....
Salammoniac (see ammonium chloride)		.... –	.... – ....
Sal soda (see sodium carbonate)		.... –	.... – ....
Salt cake	ton	.... –	32 00 – 33 00
Silver cyanide	oz.	.... –	1 35 – 1 38
Silver nitrate	oz.	.... –	40 – 41
Soda ash, light	100 lb.	2 20 – 2 25	2 30 – 2 75
Soda ash, dense	100 lb.	2 45 – 2 50	2 60 – 2 75
Sodium acetate	lb.	04½ – 04½	05 – 05½
Sodium bicarbonate	100 lb.	2 25 – 2 40	2 50 – 2 75
Sodium bichromate	lb.	08½– 08	09 – 10
Sodium bisulphate (nitre cake)	ton	5 00 – 5 25	5 50 – 6 50
Sodium bisulphite powdered, U.S.P.	lb.	05 – 05½	05½ – 06
Sodium borate (borax)	lb.	06½– 06¼	07 – 07¼
Sodium carbonate (sal sod)	100 lb.	1 90 – 2 00	2 10 – 2 40
Sodium chl rate	lb.	07½– 07¼	08 – 08½
Sodium cyanide	lb.	22 – 24	25 – 30
Sodium fluoride	lb.	11½– 12	12 – 13½
Sodium hydroxide (cau tic soda)	100 lb.	4 15 – 4 25	4 30 – 4 60
Sodium hyposulphite		.... –	03½ 03¾
Sodium nitr te	100 lb.	2 90 –	3 00 – ....
Sodium nitrite	lb.	07½– 07¾	08 – 10
Sodium peroxide, powdered	lb.	25 – 26	27 – 30
Sodium phosphate, dibasic	lb.	04½– 04½	05 – 05½
Sodium potassium tartrate (Rochelle salts)	lb.	.... –	26 – 27
Sodium prussiate, yellow	lb.	12½– 12½	13 – 14
Sodium silicate, solution (40 deg.)	lb.	1 25 – 1 35	1 40 – 1 50
Sodium silicate, solution (60 deg.)	lb.	02¾– 03	03½– 03¾
Sodium sulphate, crystals (Glauber's salt)	100 lbs.	1 50 – 1 75	2 00 – 2 25
Sodium sulphide, fu sed, 60-62 per cent (cone.)	lb.	05½– 05½	06 – 06½
Sodium sulphite, crystals	lb.	03¾– 04	04¼– 04½
Strontium nitrate, powdered	lb.	15 – 15	16 – 17
Sulphur chl ride, red	lb.	07 – 07¼	07½– 08
Su'phur, crude	ton	20 00 –22 00	.... – ....
Sulphur dioxide, liquid, cylinders extra	lb.	08 – 08½	09 – 10
Sulphur (sublimed), flour	100 lb.	.... –	2 25 – 3 10
Sulphur, roll (brimstone)	100 lb.	.... –	2 00 – 2 75
Tin bichloride, 50 per cent	lb.	18 – 19	.... – ....
Tin oxide	lb.	.... –	40 – 42
Zinc carbonate, precipitate	lb.	16 – 18	19 – 20
Zinc chloride, gran	lb.	11 – 11¼	11½– 12
Zinc cyanide	lb.	45 – 49	50 – 60
Zinc dust	lb.	12 – 13	13½– 14
Zinc oxide, XX	lb.	09 – 09½	09½– 10
Zinc sulphate	100 lb.	2 90 – 3 00	3 25 – 3 75

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	$1.10 — $1.15
Alpha-naphthol, refined	lb.	1.25 — 1.30
Alpha-naphthylamine	lb.	.35 — .40
Aniline oil, drums extra	lb.	.20 — .27
Aniline salts	lb.	.26 — .29
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.50 — ....
Benzidine, base	lb.	.85 — 1.00
Benzidine sulphate	lb.	.75 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.65 — .70
Benzene, pure, water-white, in drums (100 gal.)	gal.	.27 — .32
Benzene, 90%, in drums (100 gal.)	gal.	.25 — .28
Benzyl chloride, 95-97%, refined	lb.	.28 — .30
Benzyl chloride, tech	lb.	.20 — .25
Beta-naphthol benzoate	lb.	3.50 — 4.00
Beta-naphthol, sublimed	lb.	.70 — .75
Beta-naphthol, tech	lb.	.38 — .40
Beta-naphthylamine, sublimed	lb.	1.75 — 1.80
Cresol, U. S. P., in drums (100 lb.)	lb.	.16 — .18
Ortho-cresol, in drums (100 lb.)	lb.	.25 — .27
Cresylic acid, 97–99%, straw color, in drums	gal.	.70 — .80
Cresylic acid, 75-97%, dark, in drums	gal.	.65 — .70
Cresylic acid, 50%, first quality, drums	gal.	.45 — .50
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	1.20 — 1.25
Dimethylaniline	lb.	.41 — .50
Dinitrobenzene	lb.	.26 — .28
Dinitroclorbenzene	lb.	.20 — .30
Dinitronaphthalene	lb.	.30 — .40
Dinitrophenol	lb.	.35 — .40
Dinitrotoluene	lb.	.27 — .30
Dip oil, 25%, car lots, in drums	gal.	.40 — .45
Diphenylamine	lb.	.60 — .65
H-acid	lb.	1.20 — 1.30
Meta-phenylenediamine	lb.	1.15 — 1.20
Monochlorbenzene	lb.	.12 — .14
Monoethylaniline	lb.	1.75 — 1.85
Naphthalene crushed, in bbl	lb.	.07½— .08
Naphthalene, flake	lb.	.07 — .08
Naphthalene, balls	lb.	.08½— .09
Naphthionic acid, crude	lb.	.70 — .75
Nitrobenzene	lb.	.12 — .15
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.16 — .18
Ortho-amidophenol	lb.	3.10 — 3.20
Ortho-dichlor-benzene	lb.	.15 — .20
Ortho-nitro-phenol	lb.	.80 — .85
Ortho-nitro-toluene	lb.	.15 — .20
Ortho-toluidine	lb.	.20 — .25
Para-amidophenol, base	lb.	1.50 — 1.60
Para-amidophenol, HCl	lb.	1.75 — 1.80
Para-dichlorbenzene	lb.	.15 — .20
Paranitroaniline	lb.	.85 — 1.00
Para-nitrotoluene	lb.	.85 — .95
Para-phenylenediamine	lb.	1.80 — 2.00
Para-toluidine	lb.	1.25 — 1.40
Phthalic anhydride	lb.	.50 — .60
Phenol, U. S. P., drums	lb.	.11 — .13
Pyridine	gal.	2.00 — 3.50
Resorcinol, technical	lb.	1.75 — 1.85
Resorcinol, pure	lb.	2.25 — 2.30
Salicylic acid, tech., in bbls.	lb.	.19 — .22
Salicylic acid, U. S. P.	lb.	.20 — .25
Salol	lb.	.80 — .85
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25 — .28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14 — .16
Sulphanilic acid, crude	lb.	.30 — .35
Tolidine	lb.	1.25 — 1.35
Toluidine, mixed	lb.	.40 — .45
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.28 — .31
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — ....
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — ....

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.23 — $0.25
Beeswax, refined, light	lb.	.25 — .27
Beeswax, white pure	lb.	.42 — .45
Carnauba, Flora	lb.	.58 — .60
Carnauba, No. 2, North Country	lb.	.25 — .26
Carnauba, No. 3, North Country	lb.	.16 — .17
Japan	lb.	.17 — .17½
Montan, crude	lb.	.06½ — .06¾
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.03¼— .03½
Paraffine waxes, crude, scale 124-126 m. p.	lb.	.02½— ....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03½— .03½
Paraffine waxes, refined, 125 m.p.	lb.	.04½— .04½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04½— .05
Paraffine waxes, refined, 133-135 m.p.	lb.	.05½— .05¼
Paraffine waxes, refined, 135-137 m.p.	lb.	.05½— .06
Stearic acid, single pressed	lb.	.09 — ....
Stearic acid, double pressed	lb.	.09½— ....
Stearic acid, triple pressed	lb.	.10 — .10¼

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$5 20	— ....
Rosin E-I	280 lb.	5 80	— 6 00
Rosin K-N	280 lb.	6 50	— 6 70
Rosin W. G.-W. W.	280 lb.	6 80	— ....
Wood rosin, bbl.	280 lb.	6 25	— ....
Spirits of turpentine	gal.	.62	— ....
Wood turpentine steam dist	gal.	.60	— ....
Wood turpentine, dest. dist.	gal.	.58	— ....
Pine tar pitch, bbl	200 lb.	....	— 6 75
Tar, kiln burned, bbl. (500 lb.)	bbl.	....	— 11 50
Retort tar, bbl	500 lb.	....	— 11 50
Rosin oil, first run	gal.	36	— ....
Rosin oil, second run	gal.	38	— ....
Rosin oil, third run	gal.	.43	— ....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.	....	$1 80
Pine oil, pure, dest. dist	gal.	....	1 50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.	....	46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o b. Jacksonville, Fla.	gal.	....	35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.	....	75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.	....	35
Turpentine, crude, sp. gr., 0.900-0.970	gal.	....	1 20
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.	....	35
Pinewood creosote, ref	gal.	....	52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.41
70-72 deg., steel bbls. (85 lb.)	gal.	39
68-70 deg., steel bbls. (85 lb.)	gal.	38
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	30

Crude Rubber

Para—Upriver fine	lb.	$0 16	— 17
Upriver coarse	lb.	.09	— 09¼
Upriver caucho ball	lb.	11½—	12
Plantation—First latex crepe	lb.	14½ —	....
Ribbed smoked sheets	lb.	12	— 12¼
Brown crepe, thin, clean	lb.	15	— ....
Amber crepe No. 1	lb.	17	— ....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0 08½	— $0 09
Castor oil, AA, in bbls.	lb.	10	— 10½
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	13½	— 13½
Cocoanut oil, Ceylon grade, in bbls.	lb.	10¼	— 10½
Cocoanut oil, Cochin grade, in bbls.	lb.	11½	— 11
Corn oil, crude, in bbls.	lb.	07½	— 07½
Cottonseed oil, crude (f. o. b. mill)	lb.	05½	— 05¼
Cottonseed oil, summer yellow	lb.	07½	— 08
Cottonseed oil, winter yellow	lb.	08	— ....
Linseed oil, raw, car lots (domestic)	gal.	.76	— ....
Linseed oil, raw, tank cars (domestic)	gal.	.70	— ....
Linseed oil, in 5-bbl lots (domestic)	gal.	.79	— ....

Olive oil, Denatured	gal	$1.40 —	$1.60
Palm, Lagos	lb.	.06 —	.07
Palm, Niger	lb.	.05½ —	.05¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.05¼ —	.06
Peanut oil, refined, in bbls	lb.	.10 —	.10½
Rapeseed oil, refined in bbls	gal.	.88 —	.90
Rapeseed oil, blown, in bbls	gal.	.94 —	.95
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.07½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.05¾ —	....
FISH			
Light pressed menhaden	gal.	$0.40 —	$0.41
Yellow bleached menhaden	gal.	.42 —	....
White bleached menhaden	gal.	.44 —	....
Brown menhaden	gal.	.80 —	....

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00 —	30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00 —	26.00
Barytes, crude, 88% to 94% ba., Kings Creek	net ton	10.00 —	15.00
Barytes, floated, f.o.b. St. Louis	net ton	26.50 —	28.00
Barytes, crude, first grade, Missouri	net ton	7.00 —	....
Blanc fixe, dry	lb.	.05 —	.05¼
Blanc fixe, pulp	net ton	50.00 —	60.00
Casein	lb.	.09 —	.12
Chalk, domestic, extra light	lb.	.05 —	.05½
Chalk, domestic, light	lb.	.04½ —	.05
Chalk, domestic, heavy	lb.	.04 —	.05
Chalk, English, extra light	lb.	.05 —	.07
Chalk, English, light	lb.	.05 —	.06
Chalk, English, dense	lb.	.04½ —	.05
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	8.00 —	10.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	12.00 —	15.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	18.00 —	22.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	15.00 —	30.00
China clay (kaolin), imported, lump	net ton	15.00 —	20.00
China clay (kaolin), imported, powdered	net ton	20.00 —	30.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	8.00 —	14.00
Feldspar, crude, f.o.b. Maine	net ton	7.50 —	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00 —	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00 —	30.00
Fullers earth, f.o.b. Mines	net ton	16.00 —	17.00
Fullers earth, granular, f.o.b. Ills	net ton	15.00 —	18.00
Fullers earth, powdered, f.o.b. Fla	net ton	18.00 —	....
Fullers earth, imported, powdered	net ton	24.00 —	27.00
Graphite, Ceylon lump, first quality	lb.	.07½ —	.08
Graphite, Ceylon chip	lb.	.06 —	.06½
Graphite, high grade amorphous crude	lb.	.02½ —	.03
Pumice stone, imported, lump	lb.	.04 —	.50
Pumice stone, domestic lump	lb.	.05 —	.05½
Pumice stone, ground	lb.	.06 —	.07
Quartz (acid tower) first to head, f.o.b. Baltimore	net ton	.... —	10.00
Quartz (acid tower) 1½ to 2 in., f.o.b. Baltimore	net ton	.... —	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	.... —	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00 —	7.50
Shellac, orange fine	lb.	.70 —	....
Shellac, orange superfine	lb.	.73 —	.74
Shellac, A. C. garnet	lb.	.54 —	.55
Shellac, T. N.	lb.	.69 —	.70
Soapstone	ton	12.00 —	15.00
Sodium chloride	long ton	12.50 —	13.00
Talc, paper-making grades, f.o.b. Vermont	ton	11.00 —	20.00
Talc, roofing grades, f.o.b. Vermont	ton	8.50 —	13.00
Talc, rubber grades, f.o.b. Vermont	ton	11.00 —	18.00
Talc, powdered, Southern, f.o.b. cars	ton	10.00 —	14.00
Talc, imported	ton	35.00 —	40.00
Talc, California talcum powder grade	ton	18.00 —	40.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh		per ton	$35.00–50.00
Carborundum refractory brick, 9-in.	less than carlot	1,000	1250.00
	carload lots	1,000	1100.00
Chrome brick, f.o.b. Eastern shipping points		net ton	75–90
Chrome cement, 40–45% Cr_2O_3		net ton	45–50
Chrome cement, 40–45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points		net ton	 55
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works		1,000	40–50
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works		1,000	40–50
Magnesite brick, 9-in. straight		net ton	90
Magnesite brick, 9-in. arches, wedges and keys		net ton	100
Magnesite brick, soaps and splits		net ton	110
Silica brick, 9-in. sizes, f.o.b. Chicago district		1,000	45–55
Silica brick, 9-in. sizes, f.o.b. Birmingham district		1,000	45–55
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.		1,000	45–55

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochrome per lb. of Cr. contained, 6-8% carbon, carlots	lb.	.14 —	....
Ferrochrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.15 —	....
Ferromanganese, 76-80% Mn, domestic	gross ton	75.00 —	80.00
Ferromanganese, 76-80% Mn, English	gross ton	75.00 —	80.00
Spiegeleisen, 18-22% Mn	gross ton	30.00 —	32.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.50 —	....
Ferro-silicon, 10-15%	gross ton	42.00 —	45.00
Ferro-silicon, 50%	gross ton	70.00 —	75.00
Ferro-silicon, 75%	gross ton	140.00 —	145.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.45 —	.50
Ferrouranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40%, per lb. of contained V	lb.	5.00 —	6.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content	gross ton	$8.00 —	$10.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	unit	.40 —	.45
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	unit	.40 —	.45
Coke, foundry, f.o.b. ovens	net ton	4.00 —	4.50
Coke, furnace, f.o.b. ovens	net ton	3.00 —	3.25
Coke, petroleum, refinery, Atlantic seaboard	net ton	15.00 —	16.00
Fluorspar, lump, f.o.b. mines, New Mexico	net ton	12.50 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	18.00 —	20.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01¼ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.25 —	....
Manganese ore, chemical (MnO_2)	gross ton	55.00 —	60.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.55 —	.60
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	30.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.14 —	.14
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.14 —	.14
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	.12 —	.13
Rutile, 95% TiO_2 per lb. ore	lb.	.15 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	2.75 —	3.00
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	3.00 —	3.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.50 —	2.50
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.50 —	....
Zircon, washed, iron free	lb.	.03 —	....

Non-Ferrous Metals

New York Markets

	Cents per Lb
Copper, electrolytic	12.85–13.00
Aluminum, 98 to 99 per cent	28.0@28.5
Antimony, wholesale lots, Chinese and Japanese	5¼
Nickel, ordinary (ingot)	41.00
Nickel, electrolytic	44.00
Monel metal, sheet and blocks	35.00
Monel metal ingots	38.00
Monel metal, sheet bars	40.00
Tin, 5-ton lots, Straits	30.00
Lead, New York, spot	4.35–4.40
Lead, E. St. Louis, spot	4.20
Zinc, spot, New York	4.80
Zinc, spot, E. St. Louis	4.40–4.45

OTHER METALS

Silver (commercial)	oz.	$0.58¾
Cadmium	lb.	1.00–1.25
Bismuth (500 lb. lots)	lb.	1.50@1.55
Cobalt	lb.	4.00
Magnesium (f.o.b. Philadelphia)	lb.	1.25
Platinum	oz.	75.00
Iridium	oz.	180.00@200.00
Palladium	oz.	70.00
Mercury	75 lb.	46.00–47.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	21.25–21.50
Copper bottoms	28.75–29.00
Copper rods	20.00
High brass wire	17.25
High brass rods	14.25
Low brass wire	18.75
Low brass rods	18.75
Brazed brass tubing	27.50
Brazed bronze tubing	32.25
Seamless copper tubing	22.00
Seamless high brass tubing	20.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current	Cleveland	Chicago
Copper, heavy and crucible	9.25@9.50	9.25	9.50
Copper, heavy and wire	8.25@8.50	8.50	8.50
Copper, light and bottoms	7.25@7.25	7.50	7.25
Lead, heavy	3.25@3.50	3.25	3.25
Lead, tea	2.25@2.35	2.25	2.25
Brass, heavy	4.25@4.50	4.50	5.00
Brass, light	3.25@3.50	3.25	3.50
No. 1 yellow brass turnings	4.25@4.50	4.25	4.50
Zinc	2.00@2.50	2.00	2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes	$2.60	$3.23	$3.23
Soft steel bars	2.50	3.00	3.13
Soft steel bar shapes	2.50	3.13	3.13
Soft steel bands	2.85	3.83	3.78
Plates, ¼ to 1 in. thick	2.50	3.30	3.23

*Add 15c per 100 lb. for trucking to Jersey City and 10c for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

MOBILE—The Mobile Paint Mfg. Co., 62 South Commerce St., recently organized with a capital of $50,000, has acquired a 3-story building and will equip the structure for the manufacture of paints, colors, etc. It is proposed to develop an output of 2,000 gal. of material per day. W. A. Benson is manager.

BIRMINGHAM—The Atlas Machine & Foundry Co. has plans under way for the erection of a 1-story addition, 65 x 100 ft., estimated to cost about $10,000.

Arkansas

HOT SPRINGS—The Silver King Mining Co., 306 Citizens' National Bank Bldg., is planning for the installation of a new mining plant at its silver properties at Silver, Ark., totaling in excess of 1,000 acres. The machinery is estimated to cost about $200,000. It is planned to develop a large production. J. W. Kelly is president.

EL DORADO—The Arkansas Royalty Co., recently organized with a capital of $100,000, has preliminary plans under way for the erection of a new oil refinery on a local site. Lee Miles is president; E. E. King is secretary and treasurer.

California

SANTA CLARA—The Homer-Knowles Pottery Co., has broken ground for the construction of its proposed new local plant, estimated to cost in excess of $100,000 with equipment.

SAN MATEO—The proposed new plant to be erected here by the Illinois-Pacific Glass Co., Fifteenth and Folsom Sts., San Francisco, is estimated to cost close to $1,000,000, including machinery. The city, through the Chamber of Commerce, has been asked to donate a site. The initial plant will give employment to about 600 operatives.

LOS ANGELES—The Union Oil Co. has taken bids for the erection of a new laboratory building in the Wilmington district. It will be constructed in conjunction with a new administration building, estimated to cost about $300,000.

Colorado

DENVER—The Producers' & Refiners' Corp. has disposed of a bond issue of $3,000,000, and a portion of the proceeds will be used for plant extensions and improvements. A new skimming plant will be constructed in the vicinity of Casper, Wyo., estimated to cost about $400,000, including a new pipeline from the company wells in the Salt Lake field to this location. F. E. Kistler is president.

Connecticut

MERIDEN—The C. E. Schunack Co., manufacturer of paper boxes and containers, has awarded a contract to the H. Wales Lines Co., Holyoke, Mass., for the erection of a 2-story addition, 42 x 46 ft., with 1-story extension, 14 x 42 ft. Ground will be broken at once.

Florida

STUART—Walter J. Lloyd and associates are organizing a company with capital of $300,000 for the establishment of a local tannery and fertilizer manufacturing plant, handling shark, porpoise skins, etc. A building has been acquired, heretofore used as an ice-manufacturing plant, and machinery will be installed at an early date. J. B. Sisco is in charge of plant improvements and equipment.

TAMPA—The Southern Bottle Mfg. Co., 402 Curry Bldg., recently organized with a capital of $150,000, has awarded a contract to Oatley & Jones, Tampa, for the erection of a new local plant for the manufacture of glass bottles, jars, etc. It will be 1-story, 60 x 150 ft., with wing extension, 40 x 102 ft. The machinery installation will cost about $25,000, including a 6 to 8 ring furnace. J. F. Jones is president; and R. L. Rundell, secretary and treasurer.

Kentucky

ASHLAND—The East Kentucky Oil Association is considering the erection of a new oil refinery on a local site.

Louisiana

NEW IBERIA—The Charles Boldt Paper Mills Co., Cincinnati, O., is completing the erection of its new local mill, representing an investment of close to $1,000,000, and will soon begin production for the manufacture of paper board products.

Maryland

FREDERICK—The O. J. Keller Lime Co. has awarded a contract to the McClintic-Marshall Co., Pittsburgh, Pa., for the construction of its proposed new lime manufacturing plant. Richard K. Meade, 13 East Fayette St., Baltimore, is engineer.

BALTIMORE—The American Sugar Refining Co., 117 Wall St., New York, N. Y., has filed plans for the erection of a new brick and steel filter plant at Woodall and Clement Sts., 80 x 203 ft., for its new local sugar refinery. Stone & Webster, Inc., 120 B'way., New York, is contractor.

BALTIMORE—The Baltimore Coppersmith Co., 1914 Aliceanna St., manufacturer of copper and brass specialties, is planning for enlargements in its plant. Gustav Larsen is president.

Massachusetts

HOLYOKE—The Whiting Paper Co. has awarded a contract to the Casper Ranger Construction Co. for the erection of an addition to the machine department at its No. 2 Mill, to cost about $14,000.

CAMBRIDGE—The George Lawrence Co., Lansdowne and Green Sts., has filed plans for the erection of a new 1-story, brick and concrete plant for the manufacture of steel springs for automobile service, estimated to cost about $30,000. George M. Davis & Sons, Cambridge, have the building contract.

INDIAN ORCHARD — The Chapman Valve Mfg. Co., Pine St., manufacturer of heavy-duty gate and other type valves, has broken ground for the construction of its new 1-story foundry, 50 x 275 ft., with two wings, each 20 x 28 ft., to be equipped for the production of iron castings.

WESTFIELD — The Strathmore Paper Co., Mittineague, Mass., is reported to be negotiating for the purchase of the paper mill of the Crane Paper Co., Westfield, with consideration involving about $500,000. Upon acquisition the mill will be used by the new owner as a branch plant.

Michigan

DETROIT—The Fraser Paint & Varnish Co. is said to be planning for the rebuilding of its plant destroyed by fire May 24, with loss estimated at about $100,000, including equipment.

Missouri

KNOB NOSTER—The Johnson County Brick Co., recently organized with a capital of $125,000, has commenced the rebuilding of its local brick manufacturing plant. New kilns, both of up-draft and down-draft type, will be constructed with aggregate capacity of about 500,000 bricks. The daily output at the plant will average 40,000 finished bricks. At a later date machinery will be installed for the manufacture of hollow tile products. S. C. Garrett, Warrensburg, Mo., is secretary and manager.

New Jersey

NEWARK — The United Butchers' Fat Rendering Co., Jersey City, N. J., recently organized with a capital of $150,000, has acquired property on Doremus Ave., Newark, adjoining the chemical works of the Butterworth-Judson Corp., and heretofore held by that company. The site will be used for the erection of a new plant for the manufacture of fertilizer, tallow, glue and kindred products, utilizing the fat, hides, etc., of cattle. Plans for the new plant will be placed under way at an early date, and machinery acquired. Robert H. Bayerl, 302 Jackson Ave., Jersey City, is president.

NEWARK—E. I. du Pont de Nemours & Co. have filed plans for the erection of additions to their chemical works on Vanderpool St. to cost about $29,000, including alterations and improvements in laboratory and other buildings.

New York

NEW YORK—The Sinclair & Valentine Co., 611 West 129th St., manufacturer of lithographing inks, etc., has awarded a contract to the Vought Construction Co., 133 East 44th St., for the erection of a new 3-story plant addition, 73x125 ft., on 129th St. near B'way.

BUFFALO—The Niagara Gas Corp., recently organized to take over the artificial gas works of William J. Judge, has made application to the Public Service Commission for permission to build a new gas plant to be used for service at Buffalo and at Cheektowaga.

GLENS FALLS—The International Paper Co., 38 Broad St., New York City, has broken ground for the erection of its proposed new hydro-electric power plant on Sherman Island, near Glens Falls, to cost in excess of $1,500,000. It will be used for paper mill service in this section.

Ohio

CLEVELAND—The Sterling Brass Co., 4610 St. Clair Ave., has completed plans and will take bids at once for the erection of a new 2-story brass foundry and machine shop, 145x200 ft., at St. Catherine and 93d Sts., to cost about $100,000 with equipment. Allen Sogg, Hippodrome Bldg., is architect and engineer. S. L. Will is head.

CANTON—The Canton Brick & Fireproofing Co., recently organized with a capital of $1,500,000 to take over a number of brick and kindred plants, will soon break ground for the erection of a new brick and tile plant at Midvale, O. A branch line has been constructed from the Baltimore & Ohio R.R. to the site. Dr. W. A. Demuth, New Philadelphia, O., is president.

Pennsylvania

PHILADELPHIA — The Philadelphia Paper Mfg. Co., River Road, Manayunk, has filed plans for the erection of a new 2-story, reinforced-concrete building at its plant, 100x180 ft., to cost about $200,000.

PALMERTON—The New Jersey Zinc Co. is increasing production at its local works and has reinstated about 100 operatives after a number of weeks of idleness. A reduced wage scale has been placed into effect.

JEANNETTE—George R. West, recently resigned as president of the Westmoreland Specialty Co., Grapeville, Pa., has organized a new company to be known as George R. West & Sons, to operate a local glass-manufacturing plant. An existing building has been secured and machinery will be installed for the production of fine glassware products. Charles H. and George L. West are also members of the new organization.

ALLENTOWN—The Allentown Copperas Co., a subsidiary of C. K. Williams & Co., Easton, Pa., manufacturer of mineral colors, paints, etc., is planning for the rebuilding of the portion of its plant destroyed by fire June 9, with loss estimated at about $35,000. Robert Miller is local manager.

Tennessee

KNOXVILLE—The Knoxville Fertilizer Co., recently organized, is planning for the establishment of a new local plant for the manufacture of acid phosphate and kindred products. The initial plant is estimated to cost about $150,000. Hanson L. Dulin is president and James W. Dean secretary and treasurer.

NASHVILLE—The Victoria Oil & Refining Co. is said to be planning for the immediate rebuilding of its distilling plant recently damaged by fire, with loss of about $25,000.

Texas

SWEETWATER — The United States Gypsum Co., 205 West Monroe St., Chicago, Ill., is perfecting plans for the erection of its proposed new plant at Sweetwater, estimated to cost close to $1,000,000 with machinery.

Virginia

NORFOLK—The F. S. Royster Guano Co. has arranged for a bond issue of $2,500,000, the proceeds to be used for operations, proposed extensions, financing, etc. The company specializes in the manufacture of chemical fertilizers and affiliated products. F. S. Royster is president.

BRISTOL—The Iron City Stove & Foundry Co., recently reorganized with a capital of $40,000, is planning for extensions in its foundry and other plant departments to include the installation of new machinery. E. H. Wilkinson is president.

West Virginia

CLARKSBURG—The Eagle Convex Glass Specialty Co., Box 525, recently organized with a capital of $50,000, has acquired a local building and will install machinery for the manufacture of convex glass products, including clock faces, portrait glass, etc.; considerable beveling equipment will be installed. F. Aucremanne is president and manager.

New Companies

THE AMERICAN METALLURGICAL CORPORATION, of Boston, Mass., has been incorporated with a capital stock of $50,000, to engage in the metallurgical business. Officers are: Harry O. Breaker, of Winthrop Center, Mass., president; Kristian A. Juthe, of Newton Center, Mass., treasurer; and John R. Hanmer, 201 Devonshire St., Boston.

THE VAYCIDE CHEMICAL CORP., Birmingham, Ala., has been incorporated with a capital of $60,000 to manufacture chemicals and chemical byproducts. George B. McVay, Jr., Birmingham, is president and treasurer; M. D. McVay is secretary.

THE CONSOLIDATED SILVER MOUNTAIN MINES CO., Spokane, Wash., has been incorporated with a capital of $150,000 to operate silver mines and refining works. The incorporators are W. E. Seelye, Charles Tanner and H. A. Manchester. The company is represented by McCarthy, Edge & Lantz, Paulsen Bldg., Spokane.

THE LOS ANGELES-BROWNWOOD OIL CO., Los Angeles, Cal., has been incorporated with a capital of $250,000 to manufacture petroleum products. The incorporators are C. C. Loomis, F. R. Miner and S. S. McKinney. Lloyd Wright, 208 Currier Bldg., represents the company.

THE CORTLAND GRINDING WHEELS CORP., Chester, Mass., has been incorporated with a capital of 8,000 shares of stock, no par value, to manufacture abrasive materials. Charles J. Ayer, Plymouth, Mass., is treasurer; Ralph S. Spooner and E. Bertram Pike, Chester, are directors.

THE STETSON CHINA CO., Room 1535, 1537 South State St., Chicago, Ill., has been incorporated with a capital of $100,000 to manufacture crockery and earthenware. The incorporators are Lewis B. and Joseph Stetson.

THE D., L. & D. CORRUGATED PAPER PRODUCTS CO., New York City, has been incorporated with a capital of $75,000 to manufacture corrugated paper specialties. The incorporators are J. and A. Wolf, and M. R. Schneer, 7 Dey St.

THE IMPERIAL LEATHER CO., INC., Lynn, Mass., has been incorporated with a capital of $10,000 to manufacture leather products. F. A. Fleith is president, and Augustus S. Crovo, 93 Crest Ave., Beachmont, treasurer.

THE GREEN BAY TURPENTINE CO., Bushnell, Fla., has been incorporated with a capital of $16,000 to manufacture turpentine and affiliated products. J. F. Lambert is president, and J. H. McKnight, Bushnell, secretary and treasurer.

THE DRAYTON TUNNEL KILN CO., Brazil, Ind., has been incorporated under Delaware laws with capital of $300,000 to manufacture tunnel kilns for ceramic and other kindred service. The incorporators are William Drayton, Walter J. Kissler, Brazil; and E. Edward Dean, Indianapolis, Ind.

THE U-RUB-IT CHEMICAL CO., Philadelphia, Pa., has been incorporated with a capital of $100,000 to manufacture chemicals and chemical byproducts. The incorporators are William T. Conwell, W. L. Henderson and William F. Vogel, Philadelphia. Thomas Conwell, Lewes, Del., represents the company.

THE GRAND CHEMICAL PRODUCTS CO., Grandville and Grand Rapids, Mich., has been incorporated with a capital of $30,000 to manufacture chemicals and chemical byproducts. The incorporators are R. A. Caldwell, Grandville; Claude M. Connor and Stanley L. Barnett, Grand Rapids.

THE SUBURBAN OIL CO., Pasadena, Cal., has been incorporated with a capital of $75,000 to manufacture petroleum products. The incorporators are J. C. Cook, William W. and K. D. Butterfield. The company is represented by Ticknor, Carter & Webster, Pasadena.

THE HERCULES EXPLOSIVES CORP., New York City, has been incorporated with a capital of $4,000,000 to manufacture powder, dynamite, explosives, etc. The incorporators are R. H. Dunham, T. W. Bacchus and W. M. Annette. The company is represented by White & Case, 14 Wall St.

THE RICH SQUARE BRICK CO., Rich Square, Tex., has been incorporated with a capital of $400,000 to manufacture bricks and other burned clay products. J. R. Connell, Rich Square, is president.

THE KANGAROO POLISH CO., Newton, Mass., has been incorporated with a capital of $50,000 to manufacture polishes and kindred specialties. Robert G. Shaw 2nd, Newton Square, Mass., is president and treasurer; Albert N. Lyon and Warwick Henderson are directors.

THE MURDO OIL CO., Park and Division Sts., DuQuoin, Ill., has been incorporated with a capital of $50,000 to manufacture refined oil products. David B. Levy, Murphysboro, Ill., is the principal incorporator.

THE GUARANTEE PRESTO-WATER CHEMICAL CO., Nashville, Tenn., has been incorporated with a capital of $50,000 to manufacture chemicals and chemical byproducts. The incorporators are John H. Grant and Walter H. Moppin, Nashville.

THE VARSITY GLASS PRODUCTS CO., Passaic, N. J., has been incorporated with a capital of $35,000 to manufacture glass specialties. The incorporators are Henry J. Fixsen, Henry S. Hubschmitt and Frank M. Griswold. James H. Penn, 816 Main Ave., represents the company.

THE HUNTINGTON SUPERIOR OIL CO., Los Angeles, Cal., has been incorporated with a capital of $200,000, to manufacture petroleum products. The incorporators are W. J. Little, Allen Janes and A. P. G. Steffes. The company is represented by Randall, Bartlett & White, 605 California Bldg., Los Angeles.

THE STANDARD FERTILIZER CO., Centerville, Tenn., has been incorporated with a capital of $480,000 to manufacture fertilizer products. A. H. Grigsby is president, H. H. Campbell vice-president and C. A. Betts secretary and treasurer, all of Centerville.

THE RECTOR OIL & REFINING CO., Rector, Ark., has been incorporated with a capital of $75,000, to manufacture refined oil products. The incorporators are C. W. Weideman and W. H. Simmons, Rector.

THE CONSOLIDATD LEATHER CO., 468 Frelinghuysen Ave., Newark, N. J., has filed notice of organization to manufacture leather products. The company is headed by Philip Frank, 270 West End Ave., and Henry Frank, 970 Park Ave., both of New York City.

THE NEW JERSEY CRAYON CO., INC., Paterson, N. J., has been incorporated with a capital of $10,000 to manufacture wax crayons, chalk, etc. The incorporators are Arthur V. V. Livingston and J. M. Camagni, 21 Bridge St., Paterson.

THE MARDEN-WILD CORP., Boston, Mass., has been incorporated with a capital of $50,000 to manufacture oils, dyestuffs and kindred products. Frank W. Marden is president, and Prescott F. Wild, Winchester, Mass., treasurer.

THE GENERAL REFRACTORIES CO., Philadelphia, Pa., has been incorporated with a nominal capital of $5,000 to manufacture firebrick, furnace linings and other refractory products. The incorporators are John R. Sproul, Chester, Pa., son of Gov. Sproul; Burrows Sloan, Ardmore, Pa.; and James H. France, Philadelphia.

THE NEW ENGLAND-TEXAS OIL & REFINING SYNDICATE, INC., Springfield, Mass., has been incorporated with a capital of $1,000,000 to manufacture refined oil products. Charles N. Hawkes is president; and Frederick L. Haskins, Springfield, treasurer.

THE WESTERN PIPE & STEEL CO., OF ILLINOIS, INC., Room 7, 154 West Randolph St., Chicago, Ill., has been incorporated with a capital of $100,000 to manufacture steel products. The incorporators are Frederick T. Hoyt, John R. Lenfesty and Reuben W. Newton.

THE TAFT CENTRAL OIL CO., Los Angeles, Cal., has been incorporated with a capital of $250,000 to manufacture petroleum products. The incorporators are E. L. Mason, A. Richardson, Los Angeles; and C. C. Montgomery, 811 Washington Bldg., Pasadena, Cal.

GEORGE MANN & CO., INC., Providence, R. I., has been incorporated with a capital of 250 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are George Mann and George F. Waters, Fall River, Mass.; and Edward G. Fletcher, Providence.

THE NEWPORT MFG. CO., 2555 North Crawford Ave., Chicago, Ill., has been incorporated with a capital of $5,100 to manufacture chemical specialties. The incorporators are Aaron T. Rubin and Edward M. Seymour.

THE AMERICAN KAOLIN CO., Vincennes, Ind., has been incorporated with a capital of $250,000 to operate clay and kaolin properties. The incorporators are P. L. Donie, J. A. Kapps and W. T. Bessonette, Vincennes.

THE NICHOLSON SUPPLY CORP., Fredericksburg, Va., has been incorporated with a capital of $30,000 to manufacture mineral and vegetable oil products. The incorporators are C. O'Connor Goolrick, Fredericksburg; and George B. and Arthur D. Nicholson, Pittsburgh, Pa.

THE BRINTEX CHEMICAL CORP., New York City, has been incorporated with a capital of $10,000 to manufacture chemicals and chemical byproducts. The incorporators are J. L. Diamond, J. L. Carty and P. J. McMahon, 87 Nassau St.

THE ROCKVILLE IRON FOUNDRY CO., Rockville, Conn., has been incorporated with a capital of $50,000 to manufacture iron and steel, brass and bronze castings. The incorporators are S. and H. C. Murliess, Rockville; and A. L. McCarthy, Hartford, Conn.

Capital Increases, Etc.

THE GEORGIA SOAP CO., Jackson, Ga., has filed notice of increase in capital from $500,000 to $1,000,000.

THE CENTRAL GLASS CO., Louisville, Ky., has filed notice of increase in capital from $1,000,000 to $1,250,000.

THE AMERICAN LACQUER CO., Stratford, Conn., has filed notice of increase in capital from $20,000 to $100,000.

THE HOLMAN SOAP CO., 3104 Fox St., Chicago, Ill., has filed notice of increase in capital from $150,000 to $300,000.

THE DATTNER OIL & REFINING CO., Detroit, Mich., has filed notice of change of name to the Detroit Oil & Refining Co.

THE DU PONT AMERICAN INDUSTRIES, INC., Wilmington, Del., manufacturer of chemicals, dyes, composition products, compounds, etc., has filed notice of increase in capital from $50,000,000 to $75,000,000.

THE BRADLEY-WISE PAINT CO., 650 Santa Fe Ave., Los Angeles, Cal., has filed notice of increase in capital from $50,000 to $150,000. H. C. Bradley is secretary.

THE AMERICAN COATING MILLS, INC., Elkhart, Ind., manufacturer of coated paper products, has filed notice of increase in capital from $1,200,000 to $1,400,000.

THE STANDARD OIL CO., OF INDIANA, Indianapolis, has increased its capital from $100,000,000 to $140,000,000.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY'S summer meeting will be held at Canton, Alliance, Sebring and East Liverpool, Ohio, July 25 to 27. Headquarters will be at the Hotel Courtland, Canton, Ohio.

AMERICAN CHEMICAL SOCIETY, THE SOCIETY OF CHEMICAL INDUSTRY and the American Section of the latter society will hold a joint meeting in New York, Sept. 6 to 10.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS is holding its spring meeting June 20 to 24 at Detroit. Industrial excursions will be made to Ann Arbor, Saginaw, Midland and Bay City.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) will be held during the week of Sept. 12 in the Eighth Coast Artillery Armory, New York City.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF CHEMICAL INDUSTRY (BRITISH) at the invitation of the Montreal section will hold its annual meeting in Montreal and other Canadian cities during the week of Aug. 29, 1921. Details will be printed in this magazine from time to time.